# 1990

# AIR QUALITY CONTROL FOR ARIZONA

## Annual Report

August 1991

Honorable Fife Symington
Governor
State of Arizona

Arizona Department of Environmental Quality
Edward Z. Fox, Director

Prepared By
Office of Air Quality

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# I. BACKGROUND

## A. LEGAL AUTHORITY

Arizona derives its authority to regulate air quality from the Federal Clean Air Act and from State Statutes, both of which are described herein. The first Federal Clean Air Act was passed in 1963. It provided for grants to air pollution control agencies and contained the first federal regulatory authority. The Act was amended in 1965, 1967, 1970, 1977, and 1990. One important feature of the Act was the establishment of National Ambient Air Quality Standards (NAAQS) in 1970. These standards which are promulgated by the EPA (Environmental Protection Agency) are set at levels which protect public health and welfare. A brief discussion of the standards is provided in the following subsection B, Air Quality Standards.

Another significant aspect of the Act is the requirement of the states to formulate plans to comply with the NAAQS. Specifically, Section 110 of the Act requires states to adopt and submit to EPA plans which provides for the implementation, maintenance and enforcement of air quality standards within a specific time after standard promulgation. This plan is referred to as the State Implementation Plan (SIP), which consists of several different elements. Some of the more important SIP components are listed below:

1. Rules, including enforceable emission limitations and other measures, necessary for attainment and maintenance of the standards.

2. Compliance schedules.

3. Ambient monitoring and data analysis.

4. A permitting program, including the requirement for preconstruction review and disapproval of new or modified sources which would interfere with the attainment or maintenance of air quality standards or would significantly deteriorate air quality.

5. Source surveillance.

6. Inspection and testing of vehicles.

7. Provisions to revise the plan.

8. Legal authority to carry out the SIP.

9. Prevention of air pollution emergency episodes.

Arizona's SIP contains State statute and rules, county regulations and the nonattainment area plans required for attainment and maintenance of the NAAQS. These documents are transmitted by the Arizona Department of Environmental Quality (ADEQ) to EPA. EPA formally approves or disapproves the SIP revisions through Federal Register notices.

State statutes divide jurisdiction over air pollution sources between the State and the counties. The State has exclusive jurisdiction over air pollution sources having potential total emissions of 75 tons or more per day; air pollution sources owned or controlled by State or local government entities; motor vehicles; and other mobile air pollution sources over which the State has asserted jurisdiction. All other sources come under county authority. Currently Maricopa, Pinal, and Pima Counties have established air pollutant control districts. It should be noted, however, that in other Counties which lack air quality control programs, the State has complete jurisdiction including Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Mohave, Navajo, Yavapai, and Yuma.

In the Maricopa and Pima Counties nonattainment areas, the reagional planning agencies are required to develop plans to show how the area will attain and maintain the NAAQS. The county and cities and towns in the area must adopt and implement the plan as expeditiously as practicable. For areas which are nonattainment with respect to carbon monoxide or ozone, the plan includes transportation control measures designed to reduce motor vehicle traffic, to alleviate traffic congestion, to promote the use of cleaner fuels, and other strategies. For areas not meeting partic-culate ($PM_{10}$) standards, control strategies such as paving of roads, re-stricting off-road vehicular traffic, suppressing fugitive dust at construction sites, and other measures are key elements of the plan.

With respect to nonattainment areas, the 1990 Clean Air Act changed several key provisions including:

- Criteria for classifying nonattainment areas;
- Classifications of nonattainment areas;
- Control measures required for each classification; and
- Deadlines for compliance with NAAQS.

Other major features of the 1990 Clean Air Act addressed the following issues:

- Mobile sources;
- Air toxics;
- Acid rain;
- Permits;
- Stratospheric ozone depletion;
- Visibility Protection;
- Enforcement; and
- Miscellaneous Provisions.

## B. AIR QUALITY STANDARDS

EPA has set NAAQS for six pollutants, which are summarized in Table 1. For each pollutant EPA has adopted primary standards to protect public health and secondary standards to protect public welfare. The states are required to adopt standards which are at least as stringent as the NAAQS. In Arizona, ambient air quality standards are identical to the federal NAAQS.

A brief summary of the health and welfare effects which have been considered prior to setting ambient air quality standards is given below.

**Health and Welfare Effects** (at ambient concentrations)

| Pollutant | |
|---|---|
| Carbon Monoxide | Impairs the ability of blood to carry oxygen in the body. Cardiovascular system is primarily affected, causing angina pain in persons suffering from cardiac disease and leg pain in individuals with occlusive arterial disease. Affects other mammals in a similar manner. |
| Lead | Damages the cardiovascular, renal, and nervous systems resulting in anemia, brain damage, and kidney disease. Preschool age children are particularly susceptible to brain damage effects. Similar effects observed in other mammals. Other adverse effects on animals, microorganisms, and plants. |
| Nitrogen Dioxide | Impairs the respiratory system, causing a high incidence of acute respiratory diseases. Preschool children are especially at risk. Damages certain plants and materials. Degrades visibility due to its brownish color and its conversion to nitrate particles. Nitrate particles are also a major component of acid rain. |
| Ozone | Damages the respiratory system, reducing breathing capacity and causing chest pain, headache, nasal congestion, and sore throat. Individuals with chronic respiratory diseases are especially susceptible to ozone. Injures certain plants, trees, and materials. |
| Particulates | Causes irritation and damage to the respiratory system, resulting in difficult breathing, inducement of bronchitis, and aggravation of existing respiratory diseases. Also, certain polycyclic aromatic hydrocarbons in particulate matter are carcinogenic. Individuals with respiratory and cardiovascular diseases, children, and elderly persons are at the greatest risk. Soils and damages materials. Impairs visibility. Acid rain particulates damage materials, plants, and trees and acidify surface waters, thereby harming aquatic life. |

| | |
|---|---|
| Sulfur Dioxide | Aggravates asthma, resulting in wheezing, shortness of breath, and coughing. Healthy persons exhibit the same responses at higher exposures. Asthmatics and atopic individuals are the most sensitive groups, followed by those suffering from bronchitis, persons with emphysema, bronchiectasis, cardiovascular disease, the elderly, and children. Damages certain plants and materials. Impairs visibility and contributes to acid deposition due to the its conversion to sulfate particles. |

## C. SOURCES

### 1. Carbon Monoxide (CO)

Motor vehicles are by far the major source of CO, followed by minor sources including aircraft, controlled forestry and agricultural burning, industrial facilities, fireplaces, structural fires, railroads and off-road vehicles. Because CO is emitted mainly at ground level, it is trapped at nighttime when the lower atmosphere is stagnant due to a surface-based temperature inversion. As a result, CO concentrations are much greater during evening and early morning hours. Surface-based temperature inversions occur after sunset due to the cooling of the earth's surface as it loses heat by radiation. After sunrise, solar radiation heats the earth's surface and the lower atmosphere, resulting in dissipation of the temperature inversion. Since inversions are more severe during the fall and winter months, CO concentrations are much higher in these months. As a result, standards are exceeded primarily in the period from October through March.

### 2. Lead

Lead is emitted primarily by motor vehicles (not equipped with catalytic converters) which burn leaded gasoline. Both the use of leaded gasoline and the lead content of this fuel have decreased substantially. Ambient concentrations of lead have declined over time and are well below the standard in Phoenix and Tucson.

### 3. Nitrogen Dioxide (NO2)

Motor vehicles are the dominant source of $NO_2$ emissions, followed by power plants, and industrial and commercial facilities. In addition, $NO_2$ is also derived from the oxidation of NO (nitric oxide) in the atmosphere. NO is emitted by the same sources that emit $NO_2$. Concentrations of $NO_2$ in Arizona are well below the ambient standard.

4. Ozone

Ozone is formed in the atmosphere by the reaction of volatile hydrocarbons with nitrogen oxides (NO and $NO_2$). This chemical reaction occurs much faster in the presence of sunlight at higher temperatures. Thus, ozone concentrations are greater in the afternoon hours from May to September and occasionally exceed the standard in Phoenix. Days on which ozone concentrations are high are characterized by low wind speeds, late temperature inversion dissipation, and a relatively early wind direction shift. Hydrocarbons and nitrogen oxides, the precursors of ozone, are emitted largely by motor vehicles. Secondary sources of hydrocarbons include gasoline marketing, organic solvent usage, and miscellaneous area sources. For nitrogen oxides, secondary sources include power plants and industrial and commercial boilers.

5. Particulates

Sources of particulate matter vary widely in Arizona by region and season. In Phoenix and Tucson, motor vehicles exhaust and resuspension of road dust by traffic are the two major sources. Minor sources include construction activity and windblown dust from disturbed desert. In agricultural areas, farming activity is an additional source of fugitive dust whereas fireplaces and woodstoves emit substantial quantities of smoke in northern Arizona. In rural, industrial areas of the state, tailings piles, surface mines, quarries, material handling and storage, ore crushing and grinding, and haul roads are sources of particulate matter. Exceedances of particulate standards in the state occur chiefly in the southern and western desert regions.

6. Sulfur Dioxide ($SO_2$)

In Arizona, major sources of $SO_2$ include copper smelters and coal-fired power plants which are located in rural areas with the exception of one coal-fired power plant in Tucson. Generally, $SO_2$ concentrations near power plants are well below the standards. In the copper smelter areas, however, concentrations have occasionally exceeded the standards, although no violations of the $SO_2$ NAAQS were recorded in Arizona in 1990.

## II. PROGRAM ACTIVITY IN 1990

### A. VEHICLE EMISSIONS INSPECTION PROGRAM (VEIP)

The State's VEIP did not undergo any legislative-initiated changes during the 1990 calendar year. However, there were operational changes and improvements in the program due to the issuance of a new contract to perform the mandatory emissions test. As a result, Gordon-Darby, Inc. was awarded this contract for a seven and one-half year period, replacing Hamilton Test Systems.

During 1990, Gordon-Darby worked toward the implementation of their program which commenced January 1, 1991. This included securing real estate for each station and a new waiver lane facility now located on the west side of Maricopa County; building construction and the installation of all of the new equipment, including a computerized testing program; public relations relating to the automotive industry and the Arizona public who were affected by the dramatic change in the emissions testing system; the installation of the system's equipment in all of the waiver lane facilities and the training of the state employees at the waiver lane facilities on the new equipment. A comparison of former and new VEIP contracts shows the following:

| | NEW | OLD |
|---|---|---|
| Fee: | $5.40 | $ 7.50 |
| Heavy-duty diesel fee: | $5.40 | $24.50 |
| Number of stations: | 12 | 11 |
| Number of lanes: | 52 | 38 |
| Telephone assistance: | 5 operators | 1 operator |
| Customer Service: | Rep.ea. station | 1 phone |
| Waiver facilities: | 2 -Phx / 1 -Tuc | 1-Phx / 1-Tuc |
| Hours open per week: | 64 | 64 |
| Saturday hours: | All sta.8AM-5PM | 3 sta.8AM-3:30PM |

The new contract enhances the service to the public.

Vehicular Inspection/Maintenance Summary - 1990

| | |
|---|---|
| No. of initial emission tests: | 1,684,685 |
| No. of tampering inspections: | 1,472,854 |
| No. of vehicles tested by fleet operators: | 145,524 (approx) |
| No. of mechanics trained-proper tuneup procedures: | 1,160 (approx) |

Improvements in idle emissions of vehicles identified as not meeting standards, as a result of required repairs, were:

50% in CO     45% in HC

The Emission Research Laboratory (Laboratory) completed an extensive "In Use Vehicle Test Program" on the effectiveness of oxygenated fuels in reducing vehicular emission, which were completed November 16, 1990. The Emissions Research Laboratory completed 375 tests on 112 vehicles. Each test followed the Federal Test Procedure (FTP) requiring a minimum of 18 hours to complete. The test involved measurements of hydrocarbons from vehicles inside air tight enclosures, and measurements of hydrocarbon, carbon monoxide, nitrogen oxides, and methane from vehicles driven on a simulated urban driving course with the vehicles operated on a dynamometer. The vehicles tested were a representative group of passenger cars and light duty trucks that passed and failed the Arizona State Emissions Program, and characteristic of the vehicle fleet in the nonattainment areas. The vehicles were tested using the two oxygenated fuels, MTBE and ethanol blend, mandated for the two Arizona nonattainment areas, plus a base unleaded fuel.

Preliminary data analysis revealed that the majority of vehicles tested averaged more than a 20% reduction in carbon monoxide. The ethanol blend provided the highest reductions in carbon monoxide. On various occasions, carbon monoxide reductions on individual vehicles was greater than 60%.

The Laboratory conducted tests on compressed natural gas (CNG) conversion vehicles in the interim period before the initiation of the Winter Reid Vapor Pressure (RVP) Gasoline Test Program. One aspect which the CNG testing has revealed is that dual fueled vehicles (gasoline and CNG) often are misadjusted and the benefit gained from the use of CNG can be nullified when the vehicle is switched back to gasoline fuel.

The Laboratory is also charged with the evaluation of the effect of reducing gasoline volatility on vehicular emissions. The Winter RVP Test Program began in December 1990, and continued until ambient temperatures negated the laboratory's ability to maintain the sub-ambient temperatures required for testing in March. Seventeen "In Use" vehicles, eight fuel-injected and nine carburetted were tested. Duplicate federal exhaust and evaporative tests were performed on each vehicle. Preliminary data reduction from the test revealed significant exhaust and evaporative reductions with the decrease of RVP of gasoline. Because substantial test data was already available which could be evaluated and the federal government mandated lower RVP fuels for nonattainment areas, the Summer RVP Test Program was canceled.

As a result of the Clean Air Act Amendments of 1990, EPA is currently in the process of developing enhanced emissions inspection procedures for use in nonattainment areas. That work has included the development of a potential "transient mode" loaded test, in which a vehicle would be tested on a dynamometer during a short driving trace. As Arizona is the only state now administering a loaded test, we have followed EPA's work closely. This test proposed by EPA to date is quite lengthy and could significantly increase testing fees. The Laborotory is currently working to develop an alternative to EPA's test.

The program will consist of two major segments: The first segment will be the development of the I&M test; and the second segment will be the extensive testing of vehicles for verification. Ideally, the new I&M test will pass or fail the same vehicles that would pass or fail the FTP. The test must also be timely, economical and accurate, without imposing undue hardships on vehicle owners.

## B. OXYGENATED FUELS

Oxygenated fuels are gasoline blends that include additives containing oxygen. Alcohols and ethers are examples of such additives. Oxygenated fuels have been demonstrated to be effective at reducing tailpipe emissions of carbon monoxide since the early 1980's. In 1988, the Legislature mandated the use of oxygenated fuels in Phoenix and Tucson, from October 1 through March 31 of each winter season. The Phoenix metropolitan area commenced using oxygenated fuels in October 1989, while the Tucson program commenced in October 1990.

The Legislature also mandated a public education program, to help the driving public understand the nature and value of these fuels. ADEQ with the assistance of the Arizona Department of Weights and Measures, and the Arizona Department of Transportation hired contractors to: 1. Develop a public outreach program using advertising media and printed brochures to explain the purpose of the oxygenated fuels program and the effect of these fuels on vehicle emissions and performance; 2. Create a toll-free information line to answer basic questions about the program and direct callers to other sources of information; and 3. Train automotive technicians regarding these fuels. The program assisted people with the transition to oxygenated fuels, with the vast majority of people approving of their use. Motorists in Maricopa County drove nine billion miles on these fuels in 1990, without any verifiable case of damage to vehicles attributed to the fuels. Over 3,000 automotive technicians were trained in the 1989-1990 season, and about 500 in the 1990-1991 season.

It is estimated that the oxygenated fuels used in Maricopa County (2.3% oxygen by weight) reduced tailpipe emissions of carbon monoxide by an average of 16% across the fleet, while the blends used in the Tucson area (1.8% oxygen) reduced emissions by about 11%. The oxygen content for fuels sold in Maricopa County will increase to 2.7% beginning October 1, 1991, as a result of legislation adopted in 1991 in response to control measures contained in the Federal Implementation Plan (FIP) promulgated by EPA on January 28, 1991. This is expected to reduce carbon monoxide emissions by an additional 3%.

## C. COMPRESSED NATURAL GAS (CNG)

CNG, or compressed natural gas, has been identified by the Legislature as a desirable alternative fuel for use by state agencies and government entities throughout Arizona. Each year the ADEQ provides up to $250,000 in grant awards for the purpose of providing these entities with the financial assistance required to expand existing CNG fleets and related facilities, or to initiate new CNG projects. ADEQ has approved grant funding for CNG conversion programs in Scottsdale, Glendale, Tempe and Tucson. The goal is to establish sufficient fueling facilities and implement conversions in each of these fleets. The Department is scheduling vehicle emissions testing programs for the converted vehicles to quantify emissions reductions. The conversion of buses is a Department priority in both the Phoenix and Tucson metropolitan areas.

## D. TRAFFIC REDUCTION/CLEAN AIR CAMPAIGN

One strategy to reduce mobile source pollutants in Arizona's urban areas is to reduce the number of vehicles on the road. During 1990, both Maricopa and Pima Counties received grants from ADEQ's Air Quality Fund to continue implementation of the regional Travel Reduction Program (TRP) and Voluntary No-Drive Day Campaigns.

The Pima County TRP was instituted in 1988 through city and county ordinances, while the Maricopa County TRP was mandated by the Legislature in 1988. The TRPs place requirements on employers of 100 or more employees to "provide each regular employee with information on alternate mode options and travel reduction measures". Alternate mode choices may include transit, car and vanpool opportunities, bicycle, walking, and telecommuting. Other programs, such as the "guaranteed ride home" for workers using bus, carpool, or vanpool, have also been instituted.

In its second year, the Maricopa County TRP program began analyzing its base-year employee survey data compiled in FY 89-90. Preliminary results indicate that of those employees who responded, approximately 81% of all one-way work trips were made by single-occupant vehicles. Surveys submitted in Pima County indicate a similar level of single-occupant vehicle use.

The Voluntary No-Drive Day Campaigns in both Pima and Maricopa Counties complement the Travel Reduction Program. Media and public information networks target the travel-reduction message to the motoring public and employees. "Spare the Air" and "Don't Drive One in Five" have become familiar themes to Pima and Maricopa County motorists respectively.

E. URBAN NONATTAINMENT AREA GRANTS

A.R.S. § 49-551 gives ADEQ authority to use Air Quality Fund Fees to conduct air quality research, experiments and programs to help bring the Tucson and Phoenix areas into compliance with the federal air quality health standards. Cities, towns, counties, and regional planning agencies are eligible to receive grants. A call for proposals was issued in July, 1990. Ten of the 23 proposals received were judged by an interagency committee, as appropriate for funding. Five of the grants were finalized by the end of 1990 and are outlined below.

City of Phoenix - Diesel Particulate Traps for Buses

**Anticipated FY 90-91 ADEQ Budget:** $121,000

Project will install and test five particulate traps on existing diesel engines that power Phoenix Transit buses. The traps collect and oxidize exhaust particulate air pollutants.

City of Tucson - Urban Form

**Anticipated FY 90-91 ADEQ Budget:** $206,000

The Urban Form program is designed to evaluate and mitigate air quality and related impacts of growth through the integration of existing fragmented land use and transportation data bases; creation of evaluation criteria to guide urban development consistent with air quality goals; and research into urban development incentives/disincentives pursuant to air quality goals.

City of Tempe - Transit Planning Using Geographic Information Systems

**Anticipated FY 90-91 ADEQ Budget:** $ 46,700

The City of Tempe, in coordination with the Regional Public Transportation Authority (RPTA), Maricopa Association of Governments (MAG) and Maricopa County, will use a geographic information system application to manipulate data compiled from surveys submitted by City employees for the County's Travel Reduction Program. The analysis will produce more effective travel reduction and transportation planning as well as improved transit routing and scheduling in Tempe.

Maricopa Association of Governments - Vanpools

**Anticipated FY 90-91 ADEQ Budget:** $ 85,000

The Regional Public Transportation Authority (RPTA) has operated a vanpool program since 1987. RPTA, with ADEQ funds will continue to offer vanpooling to commuters through a third-party vanpool provider. The goal of this project is to place up to 30 vanpools in service each transporting a group of 7 to 15 commuters to work each day.

Pima Association of Governments - Travel Reduction Program Survey Validation

**Anticipation FY 90-91 ADEQ Budget: $ 25,000**

Travel Reduction Program (TRP) Surveys are sent to every employee in businesses with 100 or more employees. A Statutory goal of 5% reduction in single-occupant vehicle use is computed based solely upon completed TRP commuting-mode surveys distributed to every employee; respondents are not randomly selected. This project will determine whether the TRP survey results are representative and predictive of 1) all employees participating in the TRP; and 2) employees of com-panies not participating in the TRP. Results will produce an improved methodology to evaluate the effectiveness of the TRP.

F. REPORTS TO THE LEGISLATURE

ADEQ, with the support of the Arizona Department of Weights and Measures and Department of Transportation, is responsible for developing data and reporting to the Legislature on the following mobile source topics:

1. Feasibility of Control of NOx Emissions from In-Use Vehicles

   Summarizes the feasibility of adding a testing element for oxides of nitrogen ($NO_x$) to the Arizona Vehicle Emissions Testing Inspection Program (VEIP). Report recommends that a $NO_x$ component not be added at this time.

2. Air Quality Benefits from Expanding Boundaries of the Vehicle Emissions Inspection Program

   Concludes that aggressive enforcement of existing testing requirements could have equivalent benefits to and lower costs than the expansion of testing boundaries.

3. Analysis of the Effectiveness of Arizona's Vehicle Emissions Inspection Program (VEIP)

   Focuses on the causes of high failure rates in the loaded test portion of the VEIP. Concerns are expressed in the report whether owners of newer model year failures are receiving free repairs to which they may be entitled under the Performance Warranty provisions of the Clean Air Act.

4. <u>The Effects of Reid Vapor Pressure and Oxygenated Fuels on Carbon Monoxide and Hydrocarbon Emissions</u>

   Found that use of oxygenated fuels reduces exhaust emissions of carbon monoxide by 25-36% and exhaust hydrocarbon emissions by 15-20%, depending upon the type and condition of the vehicle. Report also describes test plans to determine the effects of gasoline volatility on carbon monoxide emissions.

5. <u>Cost Effectiveness of Carbon Monoxide Reduction Measures in Urban Arizona</u>

   Report finds that the Vehicle Emissions Inspection Program is the most cost effective measure, followed by the mandatory use of oxygenated fuels, and the Travel Reduction Program requirements for major employers.

6. <u>Causes of Violations at Monitors</u>

   Report concludes that improved traffic flow cannot be expected in the long term to reduce carbon monoxide levels at Tucson and Phoenix monitoring sites.

7. <u>Toxic Emissions from Gasoline Powered Vehicles</u>

   Highlights of the report include the findings that oxygenated fuels are expected to significantly reduce emissions of benzene, a known carcinogen, but also increase emissions of aldehydes, some of which are suspected carcinogens.

## G. PM10 STATE IMPLEMENTATION PLANS (SIPs)

The 1990 Clean Air Act Amendments, signed on November 15, 1990, set an ambitious one-year deadline for the submittal to EPA of $PM_{10}$ State Implementation Plans (SIPs) for those areas of a state not attaining the National Ambient Air Quality Standards (NAAQS) for $PM_{10}$ (particulate matter with an aerodynamic diameter of 10 microns or less). The SIP must demonstrate that:

1. The area will, with the implementation of the plan, attain the NAAQS for $PM_{10}$ by December 31, 1994 or show that attainment by that date is impracticable; and

2. Reasonably Available Control Measures (RACM) and Reasonably Available Technology (RACT) are committed to be implemented by December 10, 1993.

The following areas of Arizona have been designated as $PM_{10}$ Nonattainment Areas by EPA and must have SIPs submitted by November 15, 1991:

| | | | |
|---|---|---|---|
| Ajo | Hayden/Miami* | Paul Spur* | Rillito |
| Douglas | Nogales | Phoenix | Yuma |

The following areas of Arizona are proposed as newly designated $PM_{10}$ Nonattainment Areas and must have SIPs submitted 18 months after officially receiving a nonattainment designation by EPA:

Bullhead City Payson

*In 1990, ADEQ submitted $PM_{10}$ SIP revisions for the Hayden and Paul Spur planning areas; EPA is currently reviewing those plans.

## H. PHOENIX AND TUCSON BROWN CLOUD STUDIES

Results of the Phoenix urban haze ("Brown Cloud ") study conducted from September, 1989 through January, 1990 by Desert Research Institute (DRI) indicate that fine carbon particles are the major contributor to visibility impairment, accounting for 69% of light extinction. Motor vehicle exhaust is the main source of carbon particles in Phoenix, followed to a lesser extent by residential woodburning and other combustion sources such as power plants, industrial processes, meat cooking and aircraft.

In addition to assessing the nature of the Phoenix Urban Haze, this research yielded valuable information concerning the performance of various monitoring instruments and the usefulness of the resultant data. This information will be helpful in designing future, intensive studies of urban haze and in establishing permanent, long-term network. In Phoenix, a permanent network will be installed and operated to monitor visibility year-round, to track long-term trends and to evaluate the effectiveness of air pollution control measures. In order to facilitate this monitoring program, DRI will provide training to ADEQ in the installation and operation of instrumentation and in the interpretation of data.

In Tucson, similar findings were obtained in the pilot urban haze study conducted by DRI during the same period as for the Phoenix study. Carbon particles from motor vehicle exhaust were the dominant visibility impairing species. Minor or insignificant contributors to light extinction included sulfate and nitrate particles and nitrogen dioxide from motor vehicle exhaust, soil particles and carbon particles from wood combustion. It should be noted, however, that these results are based on a more limited degree of sampling, primarily in the central Tucson area. In order to thoroughly assess the characteristics and extent of urban haze in the Tucson metropolitan area, an expanded network is required. Current plans call for comprehensive monitoring to begin in Tucson by January, 1992.

## I. PHOENIX AND TUCSON PM10 STUDIES

During the course of the Phoenix and Tucson urban haze studies, DRI also conducted research on $PM_{10}$ in these two urban areas. As a result, DRI found that $PM_{10}$ concentrations in the Phoenix urban area were generally higher in west and central Phoenix than in Scottsdale. Conversely, the lowest concentrations were measured at remote, upwind sites and at elevated sites in the urban area. At all sites, geological material was the major component of $PM_{10}$, accounting for 40-60% of measured concentrations at the urban sites. Virtually all of this material was road dust resuspended by vehicular traffic on paved roads in the urban area. Carbonaceous particulate from motor vehicle exhaust was the second largest component, contributing 30-50% of $PM_{10}$ at the urban sites. At least 50% of this material was emitted by diesel-fueled vehicles with the remainder coming from gasoline-fueled vehicles. Vegetative burning was the third largest source of $PM_{10}$ at the two residential sites, west Phoenix and south Scottsdale, where 13-15% of $PM_{10}$ was attributed to this source. However, at the central Phoenix site and the three non-urban sites, it was a negligible source of $PM_{10}$. This geographical pattern suggests that residential woodburning was the only significant source of $PM_{10}$ from vegetative burning. Besides motor vehicle traffic and residential wood combustion, no significant sources of $PM_{10}$ were evident. Ammonium nitrate and ammonium sulfate, secondary aerosols derived from gaseous pre-cursors, were generally not detected at significant concentrations.

With respect to long-term $PM_{10}$ monitoring, ADEQ plans to operate dichotomous samplers in order to continually track source apportionment. This will provide a means to evaluate the effective-ness of various $PM_{10}$ control measures. In addition, ADEQ will purchase and operate a recently developed instrument which measures $PM_{10}$ concentrations instantaneously and automatically. Thus, the variation of $PM_{10}$ concentrations with changes in meteorological conditions and $PM_{10}$ emission rates could be correlated accurately, providing greater insight into source apportionment.

## J. AGRICULTURAL DUST CONTROL

### Alternative Tillage

ADEQ has sponsored several projects investigating alternative methods of agricultural tillage to reduce particulate emissions. The goal of these projects is to quantify the reduction of particulate emissions by comparing emissions during conventional tillage and alternative tillage operations. Alternative tillage may be defined as tillage methods that reduce soil or water loss.

Typically, more than one farm operation is performed during a pass on a field. Fewer passes are performed and less dust is emitted. The alternative operation itself leaves the field in a condition that is less conducive to dust emissions from wind erosion. ADEQ funded the University of Arizona, Department of Agricultural Engineering, to conduct research in the fall of 1990 with alternative tillage equipment. Preliminary results indicate a significant reduction in dust emissions when alternative tillage is used. Research is expected to continue in Fall and Winter 1991-1992.

### Revegetation of Retired Farmland

Another program funded by ADEQ was experimental revegetation techniques to prevent dust emissions from retired farmland. The University of Arizona, Agricultural Cooperative Extension has conducted research with different species of grasses and plants to determine a combination of techniques and vegetation that is easily adaptable to the desert croplands once those lands are retired from production. The experiment continued for three years concluding with a final harvest in the spring of 1991. The results from the harvest indicate the plant density per area of retired farmland planted. These densities will be related to dust emission reductions on an areawide basis.

## K. ROAD DUST ABATEMENT

The purpose of this program was to determine characteristics of unpaved roads in Arizona, so that potential health effects from particulate emissions and prioritization for control measures can be determined.

The Department contracted with the Midwest Research Institute (MRI) to develop mathematical relationships between particulate concentrations in the ambient air and their causative factors, namely, road characteristics and traffic conditions.

The field testing was conducted in Yuma, Pima and Pinal Counties in 1990 by MRI and the Arizona State University, Center for Advanced Research in Transportation (CART). The relationships derived from this research may be used by Arizona transportation agencies and communities as guidelines for determining control measures for unpaved roads.

## L. AMBIENT MONITORING/QUALITY ASSURANCE

Noteworthy progress in the state's ambient monitoring/quality assurance program was achieved in 1990, initiated by the hiring of a quality assurance coordinator. Subsequently, the state's quality assurance procedures were closely reviewed and revised as needed. As a result, significant improvements, especially in $PM_{10}$ sampling and analysis, were implemented. In addition, auditing of state monitoring sites was transferred from the instrumentation group to the quality assurance coordinator in order to provide independent checks on the performance of monitoring instruments. Finally, the auditing program was expanded to include checks on industrial and county monitoring sites.

## M. STATIONARY SOURCE COMPLIANCE

Surveillance of all stationary major sources was continued throughout the state for the purpose of determining compliance with state and federal regulations. ADEQ also regulates minor sources in counties where no local air pollution control program exist. These counties were: Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Mohave, Navajo, Yavapai and Yuma. Elements of this regulatory program include:

- Unannounced inspections of air pollution sources;
- Investigations in response to complaints from public, private and legislative contacts;
- Observations and reviews of emission tests of regulated sources;
- Review and determination of conditions for operating permits of existing facilities;
- Review of installation permit applications and determination of conditions for the construction of new sources;
- Technical assistance and cooperation with local and federal regulatory agencies; and
- NESHAPS (National Emission Standards for Hazardous Air Pollutants) inspections of regulated sources.

During 1990, field surveillance expanded substantially due to the hiring of additional staff. As a result, determinations of the compliance status of state-regulated sources were improved considerably. This enhancement is reflected in the work activity data for 1989 and 1990, shown in the table at the end of this section.

Significant enforcement actions completed in 1990 included the following:

- Order of Abatement was developed against VanLandingham and Associates for improper asbestos demolition in Flagstaff. The issue was resolved when proper procedures were used. Potential hazard to the environment was averted.

- Order of Abatement was developed against Arizona Public Service Company (APS). The APS issues involved operation and maintenance procedures at the Cholla Generating Station and was resolved during 1991 with a Consent Order of Abatement.

In addition to field compliance and enforcement activities, the stationary source data management system was upgraded. This improvement was achieved primarily by providing a computer for each workstation and connecting each computer to a local area network.

Presently, there are approximately 550 air pollution sources regulated under the state air pollution permit program. These consist of 36 major sources, 312 minor sources and 202 portable sources. The major sources consist of six power plants, three copper smelters, two Portland Cement companies, eight copper mines, one paper mill and one printing operation. In addition, one petroleum refinery is in the process of obtaining an installation permit.

In order to process permit applications promptly, three additional permit engineer positions were authorized by the Legislature this year. For the purpose of defining permit conditions more specifically, the permit process has been modified to include an emission rate table in each permit. This emission rate table includes a numeric emission limitation expressed in pounds per hour and tons per year for each air contaminant and each emission point.

The requirement to limit emissions of trace metals was included in the Cyprus Miami Mining Corporation permit to protect the health and welfare of the public living around the smelter.

ADEQ Air Compliance Efforts

| MEASUREMENT | JUL89-SEP89 | OCT89-DEC89 | JAN90-MAR90 | APR90-JUN90 | JUL90-SEP90 | OCT90-DEC90 |
|---|---|---|---|---|---|---|
| Field Inspections | | | | | | |
| Central | 5 | 0 | 16 | 33 | 43 | 55 |
| Northern | 42 | 34 | 49 | 35 | 24 | 14 |
| Southern | 36 | 65 | 26 | 34 | 31 | 48 |
| TOTAL | 83 | 99 | 91 | 102 | 98 | 117 |
| Notices of Violation | 10 | 12 | 12 | 19 | 17 | 21 |
| Orders of Abatement | 0 | 0 | 0 | 0 | 0 | 2 |
| NESHAP Notifications | 22 | 57 | 43 | 46 | 73 | 137 |
| Complaints | | | | | | |
| Central | 37 | 55 | 30 | 51 | 38 | 53 |
| Northern | 13 | 13 | 11 | 8 | 5 | 3 |
| Southern | 15 | 21 | 32 | 23 | 21 | 23 |
| TOTAL | 65 | 89 | 73 | 82 | 64 | 79 |
| Compliance Tests | 16 | 10 | 7 | 7 | 14 | 21 |
| Smoke School | | | | | | |
| Class Attendance | 20 | 0 | 39 | 89 | 43 | 5 |
| Field Attendance | 20 | 28 | 56 | 130 | 75 | 44 |
| CERTIFICATIONS | 17 | 26 | 40 | 28 | 56 | 21 |

## N. AIR TOXICS

A study to determine ambient concentrations of formaldehyde and acetaldehyde was conducted in Tucson from December 1990 through March 1991. The purpose of the study was to assess the effects of oxygenated fuels use on ambient aldehyde concentrations. Samples were collected over a 24-hour period on cartridges containing a chemically coated packing which reacts with aldehydes. The Tucson study was a follow-up to a baseline study conducted in December, 1989 through February, 1990 prior to the mandatory use of oxygenated fuels. Nitrogen oxides ($NO_x$) concentrations were also measured at the aldehyde site. The corresponding $NO_x$ concentrations were used to normalize the aldehyde concentrations for a "before and after" comparison. Results indicated that formaldehyde concentration levels were significantly higher in 1990-91 compared to 1989-90, but acetaldehyde concentrations were not. However, due to limited monitoring data, it cannot be concluded that the use of oxygenated fuels in Tucson was the cause of increased ambient formaldehyde concentrations.

For the purpose of long-term monitoring of urban-related air toxics, a search for a centrally located site in Phoenix was conducted. As a result, an inactive City of Phoenix water well compound at 4530 North 17th Avenue will be used to sample for air toxics and criteria pollutants. Also, a review of methodology, equipment and space requirements for laboratory analysis of air toxic samples was completed. This review indicated that the State Laboratory, Arizona Department of Health Services, must be provided substantial funds to develop and install the necessary methods and equipment. An alternative is to contract with private laboratories to perform the various analyses, but this would not be cost effective for a broad-based, long-term monitoring program.

## III. AIR QUALITY MONITORING NETWORKS

### A. MONITORING NETWORKS

In Arizona, ambient air monitoring is conducted by a number of governmental agencies and regulated industries. A list of these monitoring network operators and the areas monitored is given below.

| Agency or Industry | Area Monitored |
|---|---|
| Arizona Portland Cement Co. | Rillito |
| Arizona Public Service Co. | Joseph City |
| ASARCO, Inc. | Hayden |
| Century Power Corp. | Springerville |
| Cyprus Miami Mining Corp. | Miami |
| Magma Copper Co. | San Manuel |
| Maricopa County Health Dept. | Phoenix Metro. Area |
| National Park Service | National Monuments and Parks |
| Pima County Health Dept. | Tucson Metro. Area |
| Pinal County Air Quality Control District | Pinal County |
| Salt River Project | Page and St. Johns |
| Southern California Edison Co. | Bullhead City, AZ and Laughlin, NV |
| Tucson Electric Power Co. | Tucson |

Maps indicating the locations of the Phoenix, Tucson and statewide monitoring stations are provided in Figures 1, 2, and 3. The Maricopa and Pima County networks are operated primarily to monitor urban-related air pollution. In contrast, the industrial networks are operated to monitor emissions from certain industrial facilities. State monitors are employed for a variety of purposes, including urban, industrial, rural and background surveillance. Finally, the National Park Service sites in Arizona have the unique objective of monitoring visibility in pristine areas in accordance with federal regulations for visibility protection. Included in this activity are measurements of various optical parameters as well as pollutant concentrations.

## B. DATA REPORTING

Ambient air quality data collected in 1990 by the various networks above are summarized in Section IV of this report. In addition, Maricopa and Pima Counties and some of the companies publish annual reports which include summaries of their data.

Raw data files are maintained by each of the network operators and are available upon request to them. In addition, the U.S. Environmental Protection Agency (EPA) stores raw data submitted quarterly by Maricopa and Pima Counties and the State. EPA analyzes these data for the purposes of evaluating progress in attaining and maintaining the NAAQS and reporting trends in air quality to the President and Congress.

Maricopa and Pima Counties report pollutant concentrations in the Phoenix and Tucson urban areas each day to the public via television, radio, newspapers and telephone. The data are reported in pollutant standard index (PSI) units, that is, units of concentrations relative to the standards. These reports include the descriptor words "good", "moderate", "unhealthy", "very unhealthy", or "hazardous", depending on pollutant levels.

The industrial operators submit either monthly or quarterly data reports to the state, depending on the type of facility. In addition, they are required to report any exceedance of an air quality standard by the next working day. The report includes an explanation of the causes of the exceedance and corrective actions to be taken, if possible, to prevent future occurrences.

## IV. AIR QUALITY DATA FOR 1990

Table 2 lists the counties and towns monitored in the state and the pollutants for which data are listed.

1990 data summaries, which are tabulated in Tables 3 through 10, consist of the following:

- Mean concentrations for the calendar year;
- Highest concentrations for shorter time intervals;
- Number of exceedances of air quality standards; and
- Number of samples collected or hours monitored.

In the data summaries, the following abbreviations and footnotes were used:

**General**

| | |
|---|---|
| NA | Not Applicable |
| NR | Not Reported |

**Operators**

| | |
|---|---|
| APC | Arizona Portland Cement Company |
| APS | Arizona Public Service Company |
| ASARCO | ASARCO |
| CENT | Century Power Corporation |
| CM | Cyprus Miami Mining Corporation |
| Magma | Magma Copper Company |
| Maricopa | Maricopa County Department of Health Services, Bureau of Air Pollution Control |
| NPS | National Park Service |
| Pima | Pima County Health Department, Air Quality Control District |
| Pinal | Pinal County Air Quality Control District |
| SRP | Salt River Project |
| SCE | Southern California Edison Company |
| State | Arizona Department of Environmental Quality |
| TEP | Tucson Electric Power Company |

**Equipment**

| | |
|---|---|
| Carbon Monoxide | |
| GFC | Gas filter correlation |
| Nitrogen Dioxide | |
| Chem | Chemiluminescent |
| Ozone | |
| Chem | Chemiluminescent |
| UV | Ultraviolet absorption |
| TSP | |
| Hi-Vol | High volume air sampler |
| PM10 | |
| SA321B | Sierra Andersen 321B hi-vol |
| SA1200 | Sierra Andersen 1200 hi-vol |
| Wed | Wedding hi-vol |
| Dichot | Dichotomous |
| Imp. | Improve |
| Sulfur Dioxide | |
| Coul | Coulometric |
| Flame | Flame photometric |
| Fluor | Fluorescent |

**Footnotes:**

a. New site
b. Site terminated
c. Mean value based on a limited number of samples
d. Site operated on a seasonal schedule
e. Site operated on an event basis
f. Units for Pb are $ng/m^3$
g. Data for Pb and $SO_4$ are for particles smaller than 2.5 um

## V. AIR QUALITY TRENDS

### A. CARBON MONOXIDE

During the past 10 years in Phoenix, concentrations have declined substantially as indicated by the graphs in Figures 4 and 5. In these graphs the second highest 8-hour concentrations and the number of exceedances of the 8-hour standard were plotted. Because it is a neighborhood scale site, the trend for the Roosevelt Street monitor is more consistent than for the Indian School Road monitor, a microscale site. This also explains why concentration are lower at the Roosevelt Street site.

In Tucson concentrations decreased moderately through 1987 and then leveled out through 1990 (see Figures 4 and 5). Another major difference in Tucson is the fact that the second highest 8-hour concentrations declined below the standard (9ppm) to 7ppm. As a result, no violation of the 8-hour standard has occurred in Tucson since 1984. Because it is usually the highest recording site, the 22nd and Alvernon site data were plotted in Figures 4 and 5.

### B. LEAD

In both the Phoenix and Tucson urban areas, lead concentrations have continued to decline as illustrated in Figure 6. This decreasing trend, which began in 1978, is due to the increasing use of unleaded gasoline in catalyst-equipped cars and the reduced lead content in leaded gasoline.

### C. NITROGEN DIOXIDE

For Phoenix no long-term database is available to assess nitrogen dioxide trends. Monitoring sites were shut down in 1985 due to difficulties in operating and maintaining instruments. Moreover, data collection in the 1981 to 1985 period was significantly limited. This probably explains why annual average levels fluctuated between 30 and 59 $\mu g/m^3$ during these years. The only conclusion apparent from these data is that the Phoenix metro-politan area was in compliance with the annual standard, 100 $\mu g/m^3$.

Monitoring in the Phoenix metropolitan area was resumed in 1990 at three sites after new instruments were purchased. Average concentrations for these sites ranged from 30 to 36 $\mu g/m^3$ for six months in 1990.

In Tucson a long span of monitoring data is available, and the annual average values obtained are given below:

| | 1982 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 |
|---|---|---|---|---|---|---|---|---|---|
| Annual average: ($\mu g/m^3$) | 40 | 38 | 36 | 30 | 36 | 36 | 32 | 34 | 36 |

Site: 22nd/Craycroft

These data suggest that $NO_2$ concentrations decreased from 1982 through 1985, and then increased in 1986. Thereafter, annual means tended to vary randomly between 32 and 36 $\mu g/m^3$. Compliance with the annual standard is evident for the Tucson urban area.

D. OZONE

Referring to Figure 7, a gradual reduction in ozone levels in the Phoenix metropolitan area is apparent. This pattern is also reflected in the numbers of exceedances of the standard which are plotted in Figure 8. However, it should be noted that higher concentrations have been monitored at two special sites operated by the State in recent years. For example, in 1990 these two sites recorded second high 1-hour concentrations of 0.14 and 0.13ppm, compared with a second high of 0.11ppm from the Maricopa County network. Also, one of these state-operated sites (600 N. 40th St.) measured six exceedances while the other (2035 N. 52nd St.) monitored five exceedances. In contrast, only one exceedance was detected at each of three county sites in 1990.

In Tucson second high values have not changed as much as in Phoenix, with only a slight reduction is indicated in Figure 7. Exceedances of the ozone standard in Tucson are not plotted in Figure 8 because only one was measured (in 1982) during this period. In Yuma no discernible change since 1980 is evident if the 1980 value is considered to be an anomaly (see Figure 7). It is interesting to note that the Yuma readings are virtually the same as those for Tucson despite the large difference in populations.

E. PM10

$PM_{10}$ levels at the two oldest sites in Phoenix, 4732 S. Central and 1845 E. Roosevelt, have declined appreciably since 1986 (see Figure 9). By 1990 both sites measured annual averages below the level of the standard. Furthermore, the S. Central monitor indicated compliance with the annual standard because the 3-year average for 1988-1990 was 49 $\mu g/m^3$. However, the Roosevelt site was still not in compliance due to a 3-year average of 54 $\mu g/m^3$. The W. Earll data,which covers only the past three years, also exhibits a downward trend except in 1989. The increase in 1989 at this site is probably due to nearby street construction. As a result of the high annual average in 1989, the W. Earll site did not attain the standard in 1990 (1988-1990 average was 56 $\mu g/m^3$).

In Tucson $PM_{10}$ concentrations did not follow any consistent pattern from 1988 through 1990 (see Figure 10). Since they are the oldest $PM_{10}$ sites in Tucson, data for the Prince Rd. and Orange Grove Rd. monitors were plotted in Figure 10. Both sites were in compliance with the annual standard for the 1988-1990 period.

For other cities in Arizona, annual average $PM_{10}$ concentrations are listed in Table 11. Of all these cities, Hayden is the only one which reflects a long-term trend, a substantial decrease from 1985 through 1990. Data for the rest of the sites indicate very little change or inexplicable fluctuations from year to year. Some of these irregular variations (Douglas in 1989, Paul Spur in 1990, and Rillito in 1989) are probably due to a limited number of samples. Finally, it is interesting to note that concentrations dropped significantly at the Casa Grande, Hayden, Nogales, Rillito and Safford sites in 1990.

## F. SULFUR DIOXIDE

Major improvements were observed in Hayden and San Manuel where no exceedances of the 3-hour standard were monitored in 1990 (see Figure 11). In contrast, 1989 had been the worst year during the past five years in these two smelter towns. Miami continues to display the best conditions of the three smelter towns in Arizona, with only one exceedance of the standard (in 1987) in the past five years.

**Table 1**

Summary of Ambient Air Quality Standards
State and Federal Standards[a]
In $\mu g/m^3$ (and ppm)

| Pollutant | Averaging Time | Primary | Secondary |
|---|---|---|---|
| Carbon Monoxide[b] | 1-hr.<br>8-hr. | 40 (35)<br>10 (9) | 40 (35)<br>10 (9) |
| Nitrogen Dioxide | Annual | 100 (.05) | 100 (.05) |
| Ozone | 1-hr. | 235 (.12) | 235 (.12) |
| $PM_{10}$ | 24-hr. / Annual | 150 / 50 | 150 / 50 |
| Sulfur Dioxide | 3-hr.<br>24-hr.<br>Annual | ------<br>365 (.14)<br>80 (.03) | 1300 (.5)<br>------<br>------ |
| Lead | Calendar Quarter | 1.5 | 1.5 |

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Summary of Emergency Episode Levels
State and Federal
In $\mu g/m^3$ (and ppm)

| Pollutant | Averaging Time | Alert | Warning | Emergency | Significant Harm |
|---|---|---|---|---|---|
| Carbon Monoxide | 1-hr.<br>4-hr.<br>8-hr. | -----<br>-----<br>(15) | -----<br>-----<br>(30) | -----<br>-----<br>(40) | (125)<br>(75)<br>(50) |
| Nitrogen Dioxide | 1-hr.<br>24-hr. | 1130(.6)<br>282(.15) | 2260(1.2)<br>565(.3) | 3000(1.6)<br>750(.4) | 3750(2.0)<br>938(.5) |
| Ozone | 1-hr. | 400(.2) | 800(.4) | 1000(.5) | 1200(.6) |
| $PM_{10}$ | 24-hr. | 350(-) | 420(-) | 500(-) | 600(-) |
| Sulfur Dioxide | 24-hr. | 800(.3) | 1600(.6) | 2100(.8) | 2620(1.0) |

[a] Standards are not to be exceeded more than once per year with two exceptions. In the case of ozone and $PM_{10}$ , compliance is determined by the number of days on which the $O_3$ or $PM_{10}$ standard is exceeded. The number of exceedance days per year, based on a 3-year running average, is not to exceed 1.0.

[b] In $mg/m^3$ (and ppm)

**Table 2**

1990 Counties and Towns Monitored

| County and Town | Carbon Monoxide | Lead | Nitrogen Dioxide | Ozone | PM10 | TSP | Sulfur Dioxide |
|---|---|---|---|---|---|---|---|
| APACHE: | | | | | | | |
| Petrified Forest | | x | | x | x | | |
| St. Johns | | | x | x | x | x | x |
| Springerville | | | x | | x | x | x |
| COCHISE: | | | | | | | |
| Chiricahua | | x | | | x | | |
| Douglas | | | | | x | | |
| Paul Spur | | | | | x | | |
| COCONINO: | | | | | | | |
| Flagstaff | | | | | x | | |
| Grand Canyon | | | | x | x | | |
| Page | | | x | x | x | x | x |
| Sedona | | | | | | x | |
| GILA: | | | | | | | |
| Hayden | | | | | x | | |
| Miami | | | | | x | | x |
| Payson | | | | | x | | |

**Table 2 (Cont'd)**

1990 Counties and Towns Monitored

| County and Town | Carbon Monoxide | Lead | Nitrogen Dioxide | Ozone | PM10 | TSP | Sulfur Dioxide |
|---|---|---|---|---|---|---|---|
| GILA (CONT'D): | | | | | | | |
| Tonto (NM) | | x | | | x | | |
| Winkelman | | | | | | | x |
| GRAHAM: | | | | | | | |
| Safford | | | | | x | | |
| MARICOPA: | | | | | | | |
| Glendale | x | | | x | x | | |
| Mesa | x | | | x | x | | |
| Phoenix | x | x | x | x | x | x | x |
| Scottsdale | x | | x | x | x | | |
| MOHAVE: | | | | | | | |
| Bullhead City | | | x | | x | x | x |
| Holiday Shores | | | x | x | x | x | x |
| Riviera | | | | | x | x | x |
| NAVAJO: | | | | | | | |
| Joseph City | | | | | x | x | |
| Show Low | | | | | x | | |

**Table 2 (Cont'd)**

1990 Counties and Towns Monitored

| County and Town | Carbon Monoxide | Lead | Nitrogen Dioxide | Ozone | PM10 | TSP | Sulfur Dioxide |
|---|---|---|---|---|---|---|---|
| PIMA: | | | | | | | |
| Ajo | | | | | x | | |
| Green Valley | | | | | x | x | |
| Organ Pipe (NM) | | | | | x | | |
| Rillito | | | | | x | | |
| Saguaro | | x | | | x | | |
| Sahuarita | | | | | | x | |
| Tucson | x | x | x | x | x | x | x |
| PINAL: | | | | | | | |
| Apache Junction | | | | | x | | |
| Casa Grande | x | | | x | x | | |
| Mammoth | | | | | | x | |
| Marana | | | | | | x | |
| Oracle | | | | | x | | x |
| San Manuel | | | | | x | | x |
| Stanfield | | | | | x | | |

**Table 2 (Cont'd)**

1990 Counties and Towns Monitored

| County and Town | Carbon Monoxide | Lead | Nitrogen Dioxide | Ozone | PM10 | TSP | Sulfur Dioxide |
|---|---|---|---|---|---|---|---|
| SANTA CRUZ: | | | | | | | |
| Nogales | | | | | x | | |
| YAVAPAI: | | | | | | | |
| Clarkdale | | | | | x | | |
| Montezuma Castle(NM) | | | | | | x | |
| Nelson | | | | | | x | |
| Prescott | | | | | | x | |
| YUMA: | | | | | | | |
| Yuma | | | | x | x | | |

**Table 3**

1990 Carbon Monoxide Data (in ppm)

| County and City | Site Location | Operator | Method | 1-HR AVERAGE Max | 1-HR AVERAGE 2ndHi | 8-HR AVERAGE Max | 8-HR AVERAGE 2ndHi | NUMBER OF EXCEEDANCES Day | NUMBER OF EXCEEDANCES Times | Number of Samples |
|---|---|---|---|---|---|---|---|---|---|---|
| MARICOPA: | | | | | | | | | | |
| Arizona Hwy.[d] | 2039 W Lewis | State | GFC | 12.0 | 11.5 | 8.8 | 7.8 | 0 | 0 | 3549 |
| Glendale | 6000 W Olive | Maricopa | GFC | 8.4 | 7.7 | 5.0 | 4.8 | 0 | 0 | 7697 |
| Mesa | Broadway & Brooks | Maricopa | GFC | 5.1 | 3.4 | 2.6 | 2.5 | 0 | 0 | 5293 |
| Phoenix | 4732 S Central | Maricopa | GFC | 9.5 | 8.5 | 5.4 | 5.3 | 0 | 0 | 8177 |
| Phoenix | 1845 E Roosevelt | Maricopa | GFC | 13.2 | 12.7 | 9.5 | 8.8 | 0 | 0 | 8444 |
| Phoenix | 601 E Butler Dr | Maricopa | GFC | 11.6 | 11.3 | 5.6 | 5.5 | 0 | 0 | 8591 |
| Phoenix | 2750 W Indian School Rd | Maricopa | GFC | 12.8 | 12.8 | 11.6 | 10.0 | 4 | 4 | 6239 |
| Phoenix | 3847 W Earll | Maricopa | GFC | 10.9 | 10.9 | 9.1 | 8.6 | 0 | 0 | 8177 |
| Scottsdale | 2857 N Miller | Maricopa | GFC | 11.9 | 10.8 | 7.8 | 7.7 | 0 | 0 | 8200 |
| Scottsdale | 13665 N Scottsdale Rd | Maricopa | GFC | 5.9 | 5.9 | 3.0 | 2.9 | 0 | 0 | 8699 |
| Scottsdale | 24301 N Alma School Rd | Maricopa | GFC | 5.5 | 5.1 | 1.9 | 1.8 | 0 | 0 | 2420 |
| PIMA: | | | | | | | | | | |
| Tucson | 150 W Congress | Pima | NDIR | 13.8 | 9.3 | 4.4 | 4.3 | 0 | 0 | 8009 |
| Tucson | 22nd & Craycroft | Pima | NDIR | 6.8 | 6.2 | 3.1 | 3.1 | 0 | 0 | 7955 |
| Tucson | 22nd & Alvernon | Pima | NDIR | 12.8 | 11.7 | 6.8 | 6.5 | 0 | 0 | 8337 |
| Tucson | 346 N Cloverland | Pima | NDIR | 6.8 | 6.3 | 3.1 | 3.0 | 0 | 0 | 4806 |

**Table 3 (Cont'd)**

1990 Carbon Monoxide Data (in ppm)

| County and City | Site Location | Operator | Method | 1-HR AVERAGE | | 8-HR AVERAGE | | NUMBER OF EXCEEDANCES | | Number of Samples |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Max | 2ndHi | Max | 2ndHi | Day | Times | |
| PIMA (CONT'D): | | | | | | | | | | |
| Tucson | 2745 N Cherry | Pima | NDIR | 7.7 | 7.6 | 4.5 | 4.3 | 0 | 0 | 4949 |
| Tucson | Broadway & Craycroft | Pima | NDIR | 10.0 | 9.7 | 6.7 | 6.1 | 0 | 0 | 8366 |
| Tucson | 4829 N Sabino Canyon Rd | Pima | NDIR | 5.1 | 4.8 | 3.0 | 3.0 | 0 | 0 | 6236 |
| Tucson | 12101 N Camino deOste | Pima | NDIR | 2.1 | 1.8 | 1.6 | 1.6 | 0 | 0 | 5619 |
| PINAL: | | | | | | | | | | |
| Casa Grande | Airport - N Pinal Ave | Pinal | GFC | 3.0 | 2.9 | 2.7 | 2.5 | 0 | 0 | 4080 |

STATE AND FEDERAL STANDARD (ppm): 1-Hour Average 35 8-Hour Average 9

**Table 4**

1990 Lead Data (in $\mu g/m^3$)
In TSP or $PM_{10}$

| County and City | Site Location | Operator | IN | QUARTERLY AVERAGE 1 | 2 | 3 | 4 | NUMBER OF SAMPLES 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| APACHE: | | | | | | | | | | | |
| Petrified Frst. | 1 mi. N of Park Hdqrtrs | NPS | PM10 | N/R | N/R | N/R | N/R | N/R | N/R | N/R | N/R |
| COCHISE: | | | | | | | | | | | |
| Chiricahua NM | Faraway Ranch | NPS | PM10 | N/R | N/R | N/R | N/R | N/R | N/R | N/R | N/R |
| COCONINO: | | | | | | | | | | | |
| Grand Canyon NM | Hopi Point | NPS | PM10 | N/R | N/R | N/R | N/R | N/R | N/R | N/R | N/R |
| GILA: | | | | | | | | | | | |
| Tonto | Maintenance Station | NPS | PM10 | N/R | N/R | N/R | N/R | N/R | N/R | N/R | N/R |
| MARICOPA: | | | | | | | | | | | |
| Glendale | 6000 W Olive | Maricopa | PM10 | N/R | N/R | N/R | N/R | N/R | N/R | N/R | N/R |
| Phoenix | 1845 E Roosevelt | Maricopa | TSP | 0.05 | 0.02 | 0.01 | 0.07 | 13 | 10 | 8 | 6 |
| | | | PM10 | 0.03 | 0.0 | N/R | N/R | 14 | 12 | N/R | N/R |
| Phoenix | 4732 S Central | Maricopa | PM10 | 0.02 | 0.0 | 0.02 | 0.02 | 14 | 12 | 14 | 16 |
| Phoenix | 1826 W McDowell | Maricopa | TSP | 0.08 | 0.0 | 0.05 | 0.09 | 11 | 13 | 13 | 11 |
| Phoenix | 3847 W Earll | Maricopa | PM10 | 0.02 | 0.02 | 0.02 | 0.03 | 15 | 15 | 15 | 14 |
| Scottsdale | 2857 N Miller Rd | Maricopa | PM10 | 0.01 | 0.01 | 0.01 | 0.02 | 14 | 13 | 15 | 15 |

**Table 4 (Cont'd)**

1990 Lead Data (in $\mu g/m^3$)
In TSP or $PM_{10}$

| County and City | Site Location | Operator | IN | QUARTERLY AVERAGE 1 | 2 | 3 | 4 | NUMBER OF SAMPLES 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PIMA: | | | | | | | | | | | |
| Saguaro NM | Rincon Mountain Unit | NPS | PM10 | N/R | N/R | N/R | N/R | N/R | N/R | N/R | N/R |
| Tucson | 1016 W Prince Rd | Pima | TSP | N/R | N/R | N/R | 0.05 | 0 | 0 | 0 | 8 |
| Tucson | 1016 W Prince Rd | Pima | PM10 | 0.03 | 0.02 | 0.00 | 0.00 | 15 | 10 | 13 | 1 |
| Tucson | Broadway & Swan | Pima | PM10 | 0.00 | 0.00 | 0.00 | 0.01 | 15 | 10 | 12 | 16 |

STATE AND FEDERAL STANDARD ($\mu g/m^3$): Calendar Quarter Average
(Primary and Secondary) 1.5

**Table 5**

1990 Nitrogen Dioxide Data (in $\mu g/m^3$)

| County and City | Site Location | Operator | Method | Average | Maximum 1-HR | Maximum 24-HR | No. of 1-HR Samples |
|---|---|---|---|---|---|---|---|
| APACHE: | | | | | | | |
| St. Johns | Mesa Parada | SRP | Chem | 6 | 23 | 9 | 6697 |
| Springerville | Airport | CENT | Chem | 4 | 32 | 9 | 7496 |
| Springerville | 4 mi NE of town | CENT | Chem | 4 | 51 | 13 | 7832 |
| Springerville | 1 mi NNE of unit 1 stack | CENT | Chem | 4 | 58 | 9 | 8498 |
| Springerville | 1 mi ESE of unit 1 stack | CENT | Chem | 4 | 83 | 15 | 8330 |
| Springerville | 1 mi SSE of unit 1 stack | CENT | Chem | 4 | 72 | 15 | 8597 |
| Springerville | 12.2 mi SE of unit 1 stack | CENT | Chem | 4 | 38 | 15 | 1660 |
| COCONINO: | | | | | | | |
| Page | Glen Canyon Dam | SRP | Chem | 3 | 54 | 24 | 7147 |
| MARICOPA: | | | | | | | |
| Arizona Hwy.[a] | 2039 W Lewis | State | Chem | 43[c] | 387 | 83 | 3807 |
| Phoenix[a] | 1845 E Roosevelt | Maricopa | Chem | 30[c] | 212 | 88 | 4890 |
| Phoenix[a] | 3847 W Earll | Maricopa | Chem | 35[c] | 162 | 98 | 3782 |
| Scottsdale[a] | 2857 N Miller | Maricopa | Chem | 34[c] | 203 | 81 | 3900 |
| MOHAVE: | | | | | | | |
| Bullhead City | 224 N Main | SCE | Chem | 36 | 169 | 75 | 8492 |

**Table 5 (Cont'd)**

1990 Nitrogen Dioxide Data (in $\mu g/m^3$)

| County and City | Site Location | Operator | Method | Average | Maximum 1-HR | Maximum 24-HR | No. of 1-HR Samples |
|---|---|---|---|---|---|---|---|
| MOHAVE (CONT'D): | | | | | | | |
| Holiday Shores[a] | 1436 Tonto Dr | SCE | Chem | --- | 167 | 102 | 6395 |
| PIMA: | | | | | | | |
| Tucson | 22nd & Craycroft | Pima | Chem | 36 | 214 | 211 | 8150 |
| Tucson | 150 W Congress | Pima | Chem | 51 | 218 | 80 | 2429 |
| Tucson | 4591 N Pomona Ave | Pima | Chem | 41 | 182 | 150 | 7302 |

STATE AND FEDERAL STANDARD ($\mu g/m^3$): Annual Average 100
(Primary and Secondary)

**Table 6**

1990 Ozone Data (in ppm)

| County and City | Site Location | Operator | Method | 1-HR MAX Day | MAX 2nd HI Day | Number of Exceedances | Number of Samples |
|---|---|---|---|---|---|---|---|
| APACHE: | | | | | | | |
| Petrified Frst[a] | 1 mi from Visitor Cntr | NPS | UV | .10 | .09 | 0 | 7814 |
| St. Johns | Mesa Parada | SRP | UV | .09 | .09 | 0 | 7759 |
| COCHISE: | | | | | | | |
| Chiricahua NM | Western entrance to NM | EPA | UV | .14 | .09 | 1 | 8347 |
| COCONINO: | | | | | | | |
| Grand Canyon | 2 mi W of Hopi Point | NPS | UV | .07 | .07 | 0 | 7169 |
| Grand Canyon | 2 mi W of Hopi Point | EPA | UV | .09 | .09 | 0 | 8646 |
| Page | Glen Canyon Dam | SRP | UV | .07 | .07 | 0 | 8576 |
| MARICOPA: | | | | | | | |
| Glendale | 6000 W Olive | Maricopa | UV | .13 | .11 | 1 | 8026 |
| Mesa | Broadway & Brooks | Maricopa | UV | .10 | .09 | 0 | 7364 |
| Phoenix[d] | 2035 52nd St | State | UV | .17 | .14 | 5 | 2849 |
| Phoenix | 1845 E Roosevelt | Maricopa | UV | .11 | .11 | 0 | 7800 |
| Phoenix | 601 E Butler | Maricopa | UV | .11 | .11 | 0 | 8553 |
| Phoenix[d] | 600 N 40th St | State | UV | .16 | .13 | 6 | 2681 |
| Phoenix | 3847 W Earll | Maricopa | UV | .13 | .12 | 1 | 8554 |

**Table 6 (Cont'd)**

1990 Ozone Data (in ppm)

| County and City | Site Location | Operator | Method | 1-HR MAX Day | MAX 2nd HI Day | Number of Exceedances | Number of Samples |
|---|---|---|---|---|---|---|---|
| MARICOPA CONT'D: | | | | | | | |
| Phoenix | 3315 W Indian School Rd | Maricopa | UV | N/R | | | |
| Phoenix | 4732 S Central | Maricopa | UV | .13 | .11 | 1 | 7948 |
| Scottsdale | 2857 N Miller | Maricopa | UV | .11 | .11 | 0 | 8390 |
| Scottsdale | 13665 N Scottsdale Rd | Maricopa | UV | .11 | .11 | 0 | 8552 |
| Scottsdale | 24301 N Alma School Rd | Maricopa | UV | .11 | .10 | 0 | 7868 |
| PIMA: | | | | | | | |
| Saguaro NM E | 3905 S Old Spanish Trl | NPS | UV | .10 | .10 | 0 | 7962 |
| Tucson | 150 W Congress | Pima | UV | .09 | .09 | 0 | 8353 |
| Tucson | 22nd & Craycroft | Pima | UV | .09 | .09 | 0 | 8455 |
| Tucson | 4591 N Pomona | Pima | UV | .10 | .09 | 0 | 8207 |
| Tucson | 11330 S Houghton | Pima | UV | .10 | .10 | 0 | 7724 |
| Tucson | 12101 N Camino deOeste | Pima | UV | .10 | .09 | 0 | 8357 |
| Tucson | 4829 W Sabino Canyon Rd | Pima | UV | .09 | .09 | 0 | 7406 |
| PINAL: | | | | | | | |
| Casa Grande | 926 W Gila Bend Hwy | Pinal | UV | .08 | .07 | 0 | 6135 |
| Casa Grande | Airport - N Pinal Ave | State | UV | .09 | .08 | 0 | 1354 |

**Table 6 (Cont'd)**

1990 Ozone Data (in ppm)

| County and City | Site Location | Operator | Method | 1-HR MAX Day | MAX 2nd HI Day | Number of Exceedances | Number of Samples |
|---|---|---|---|---|---|---|---|
| YUMA: | | | | | | | |
| Yuma[d] | 1485 Second Ave | State | UV | .10 | .09 | 0 | 2748 |

STATE AND FEDERAL STANDARD: (Primary and Secondary) The standard is .12ppm (235 $\mu g/m^3$) for the maximum daily 1-hour concentration, not to be exceeded more than three times in three years. No more than 1.0 exceedances per year over the last three years is permitted.

**Table 7**

1990 $PM_{10}$ Data (in $\mu g/m^3$)

| County and City | Site Location | Operator | Method | Annual Arithmetic Mean | 24-HR AVERAGE Max | 24-HR AVERAGE 2ndHi | NUMBER OF EXCEEDANCES 150 $\mu g/m3$ | Number of Samples |
|---|---|---|---|---|---|---|---|---|
| APACHE: | | | | | | | | |
| Petrified Frst | 1 mi. from Visitor Cntr | NPS | Imprve | $9^c$ | 28 | -- | 0 | 35 |
| St. Johns | Mesa Parada | SRP | Dichot | N/A | | | | |
| St. Johns | Patterson Wellfield | SRP | Dichot | N/A | | | | |
| Springerville | Coyote Hills 10.5m SSW of stack | Cent | Dichot | $19^c$ | 74 | 63 | 0 | 337 |
| Springerville | Plant 1 mi NE of stack | Cent | Dichot | $33^c$ | 126 | 77 | 0 | 59 |
| COCHISE: | | | | | | | | |
| Chiricahua NM | | NPS | Imprve | $9^c$ | 21 | -- | 0 | 32 |
| Douglas | City Park | State | SA1200 | $38^c$ | 133 | 113 | 0 | 44 |
| Paul Spur | Housing area | State | SA322 | $79^c$ | 261 | 205 | 4 | 39 |
| COCONINO: | | | | | | | | |
| Flagstaff | Cherry & Agassiz | State | Wedd'g | 29 | 77 | 70 | 0 | 51 |
| Grand Canyon | Hopi Point | NPS | Imprve | $8^c$ | 24 | -- | 0 | 40 |
| GILA: | | | | | | | | |
| Hayden | Jail | State | Wedd'g | 39 | 66 | 64 | 0 | 55 |
| Miami Tailings | Southwest Gas Yd-Hwy 88 | State | SA1200 | $27^c$ | 63 | 58 | 0 | 44 |

**Table 7 (Cont'd)**

1990 $PM_{10}$ Data (in $\mu g/m^3$)

| County and City | Site Location | Operator | Method | Annual Arithmetic Mean | 24-HR AVERAGE | | NUMBER OF EXCEEDANCES 150 $\mu g/m3$ | Number of Samples |
|---|---|---|---|---|---|---|---|---|
| | | | | | Max | 2ndHi | | |
| GILA (CONT'D): | | | | | | | | |
| Payson | County courthouse | State | SA321B | 67 | 287 | 182 | 5 | 54 |
| Tonto | Maintenance Station | NPS | Imprve | 11[c] | 24 | -- | 0 | 37 |
| GRAHAM: | | | | | | | | |
| Safford | 523 Tenth Ave | State | SA321B | 28 | 87 | 57 | 0 | 53 |
| MARICOPA: | | | | | | | | |
| Chandler | 1475 E Pecos Rd | Maricopa | SA1200 | 49 | 117 | 114 | 0 | 57 |
| Glendale | 6000 W Olive | Maricopa | SA321B | 44[c] | 81 | 77 | 0 | 16 |
| Mesa | Broadway & Brooks | Maricopa | SA1200 | 36 | 61 | 60 | 0 | 58 |
| Phoenix | 4732 S Central | Maricopa | SA321B | 40 | 92 | 75 | 0 | 56 |
| Phoenix | 3847 W Earll | Maricopa | SA321B | 46 | 96 | 94 | 0 | 59 |
| Phoenix | 1845 E Roosevelt | Maricopa | SA321B | 46[c] | 89 | 73 | 0 | 37 |
| Scottsdale | 2857 N Miller Rd | Maricopa | SA321B | 37 | 65 | 64 | 0 | 57 |
| Scottsdale | 13665 N Scottsdale Rd | Maricopa | SA1200 | 33 | 150 | 89 | 0 | 57 |
| Scottsdale[b] | 24301 N Alma School Rd | Maricopa | SA321B | 20 | 35 | 34 | 0 | 37 |
| MOHAVE: | | | | | | | | |
| Bullhead City | 224 N Main | SCE | SA321B | 39 | 143 | 139 | 0 | 61 |

**Table 7 (Cont'd)**

1990 $PM_{10}$ Data (in $\mu g/m^3$)

| County and City | Site Location | Operator | Method | Annual Arithmetic Mean | 24-HR AVERAGE Max | 24-HR AVERAGE 2ndHi | NUMBER OF EXCEEDANCES 150 $\mu g/m3$ | Number of Samples |
|---|---|---|---|---|---|---|---|---|
| MOHAVE (CONT'D): | | | | | | | | |
| Holiday Shores | 1436 Tonto Dr | SCE | SA321B | 33 | 109 | 76 | 0 | 60 |
| Riviera | Fort Mohave | SCE | SA321B | 31 | 144 | 71 | 0 | 61 |
| NAVAJO: | | | | | | | | |
| Joseph City | Third & Tanner | APS | Wedd'g | 21 | 65 | 61 | 0 | 61 |
| Show Low | Deuce of Clubs Ave | State | SA1200 | 22 | 59 | 47 | 0 | 46 |
| PIMA: | | | | | | | | |
| Ajo | Well Rd | State | SA321B | 44[c] | 121 | 112 | 0 | 44 |
| Corona De Tucsn | 22000 S Haughton | Pima | SA1200 | 16 | 53 | 49 | 0 | 50 |
| Green Valley | 245 W Esperanza | Pima | SA1200 | 19 | 61 | 59 | 0 | 56 |
| Organ Pipe NM | Visitor's Center | State | SA321B | 23 | 108 | 108 | 0 | 52 |
| Rillito | 8820 W Water | State | SA321B | 40 | 94 | 70 | 0 | 51 |
| Rillito | Gremmler Residence | CAL-MAT | Wedd'g | 30 | 143 | 99 | 0 | 327 |
| Saguaro NM | 3905 S Old Spanish Trl | NPS | | N/R | N/R | N/R | N/R | N/R |
| Tucson | Broadway & Swan | Pima | SA1200 | 29 | 88 | 73 | 0 | 56 |
| Tucson | 150 W Congress St | Pima | SA1200 | 38 | 134 | 117 | 0 | 299 |
| Tucson | Golf Link & Harrison | Pima | SA1200 | 25 | 68 | 61 | 0 | 58 |

**Table 7 (Cont'd)**

1990 $PM_{10}$ Data (in $\mu g/m^3$)

| County and City | Site Location | Operator | Method | Annual Arithmetic Mean | 24-HR AVERAGE Max | 24-HR AVERAGE 2ndHi | NUMBER OF EXCEEDANCES 150 µg/m3 | Number of Samples |
|---|---|---|---|---|---|---|---|---|
| PIMA (CONT'D): | | | | | | | | |
| Tucson | .5m E Irv'gton &Alvrnon | TEP | SA321B | 27 | 63 | 51 | 0 | 59 |
| Tucson | 3401 W Orange Grove | Pima | SA321B | 38 | 134 | 116 | 0 | 284 |
| Tucson | 1016 W Prince Rd | Pima | SA1200 | 42[c] | 89 | 75 | 0 | 44 |
| Tucson | 1810 S 6th Ave | Pima | SA1200 | 46 | 144 | 108 | 0 | 52 |
| Tucson | 2nd St & Palm Ave | Pima | SA1200 | 38 | 81 | 72 | 0 | 51 |
| Tucson | 7290 E Tanque Verde | Pima | SA1200 | 26 | 77 | 58 | 0 | 59 |
| PINAL: | | | | | | | | |
| Apache Junction | County Court | Pinal | Wedd'g | 23[c] | 59 | 50 | 0 | 45 |
| Casa Grande | 401 Marshall Rd | State | Wedd'g | 32 | 75 | 57 | 0 | 56 |
| Casa Grande | 926 W Gila Bend Hwy | Pinal | Wedd'g | 37 | 182 | 102 | 1 | 56 |
| Oracle | Behind Courthouse | Magma | Dichot | 12[c] | 27 | 16 | 0 | 14 |
| Stanfield | County Courthouse | Pinal | Wedd'g | 38 | 126 | 114 | 0 | 49 |
| SANTA CRUZ: | | | | | | | | |
| Nogales | US Post Office | State | SA321B | 52 | 175 | 108 | 1 | 52 |
| YAVAPAI: | | | | | | | | |
| Clarkdale | Clarkdale Fire Station | State | Wedd'g | 28[c] | 141 | 120 | 0 | 41 |

**Table 7 (Cont'd)**

1990 $PM_{10}$ Data (in $\mu g/m^3$)

| County and City | Site Location | Operator | Method | Annual Arithmetic Mean | 24-HR AVERAGE Max | 24-HR AVERAGE 2ndHi | NUMBER OF EXCEEDANCES 150 $\mu g/m3$ | Number of Samples |
|---|---|---|---|---|---|---|---|---|
| YUMA: | | | | | | | | |
| Yuma | 2795 Avenue B | State | SA321B | 57 | 270 | 118 | 1 | 50 |

FEDERAL STANDARDS ($\mu g/m^3$): (Primary and Secondary)

Annual Arithmetic Mean 50

24-Hour Average 150

**Table 8**

1990 TSP Data
High Volume Sampler (in $\mu g/m^3$)

| County and City | Site Location | Operator | Annual Geometric Mean | 24-HR Max | 24-HR 2ndHi | Number of Samples |
|---|---|---|---|---|---|---|
| APACHE: | | | | | | |
| St. Johns | Airport | SRP | 15 | 52 | 47 | 60 |
| St. Johns | Mesa Parada | SRP | 10 | 58 | 36 | 59 |
| St. Johns | Patterson Wellfield | SRP | 11 | 65 | 30 | 61 |
| Springerville | Airport | Cent | 17 | 94 | 93 | 50 |
| Springerville | 4 mi NE of town | Cent | 9 | 65 | 51 | 49 |
| Springerville | 1 mi NNE of unit 1 stack | Cent | 19 | 73 | 60 | 59 |
| Springerville | 12.2 mi SE of unit 1 stack | Cent | 7 | 58 | 47 | 55 |
| COCONINO: | | | | | | |
| Page | Glen Canyon Dam | SRP | 14 | 66 | 45 | 52 |
| Page | Airport | SRP | 40 | 166 | 150 | 60 |
| Sedona | Post Office | State | $31^c$ | 88 | 61 | 20 |
| MARICOPA: | | | | | | |
| Phoenix | 1845 E Roosevelt | Maricopa | $101^c$ | 182 | 169 | 38 |
| Phoenix | 1826 W McDowell | Maricopa | 109 | 235 | 204 | 49 |

**Table 8 (Cont'd)**

1990 TSP Data
High Volume Sampler (in $\mu g/m^3$)

| County and City | Site Location | Operator | Annual Geometric Mean | 24-HR Max | 24-HR 2ndHi | Number of Samples |
|---|---|---|---|---|---|---|
| MOHAVE: | | | | | | |
| Bullhead City | 224 N Main | SCE | 88 | 315 | 230 | 61 |
| Holiday Shores | 1436 Tonto Dr | SCE | 62 | 293 | 150 | 60 |
| Riviera | Fort Mohave | SCE | 58 | 313 | 185 | 60 |
| NAVAJO: | | | | | | |
| Joseph City | 3rd St N & Tanner | APS | 50 | 267 | 128 | 61 |
| PIMA: | | | | | | |
| Green Valley[b] | 245 West Esperanza | Pima | 30 | 143 | 140 | 46 |
| Sahuarita | Junior High School | Pima | 33 | 244 | 109 | 56 |
| Tucson[b] | 3401 W Orange Grove | Pima | 82[c] | 312 | 212 | 45 |
| Tucson[b] | 1810 S Sixth Ave | Pima | 81[c] | 175 | 151 | 44 |
| Tucson | Second St & Palm Ave | Pima | 70[c] | 180 | 161 | 45 |
| Tucson[a] | 1016 W Prince | Pima | 62[c] | 89 | 88 | 9 |
| PINAL: | | | | | | |
| Mammoth | County Courthouse | Pinal | 37 | 122 | 101 | 50 |
| Marana | Pinal Air Park | Pinal | 58 | 186 | 160 | 46 |

**Table 8 (Cont'd)**

1990 TSP Data
High Volume Sampler (in $\mu g/m^3$)

| County and City | Site Location | Operator | Annual Geometric Mean | 24-HR Max | 24-HR 2ndHi | Number of Samples |
|---|---|---|---|---|---|---|
| YAVAPAI: | | | | | | |
| Nelson | .3 mi W of lime plant | State | 74 | 318 | 284 | 48 |
| Prescott | City Administration | State | 44[c] | 135 | 102 | 45 |

**Table 9**

1990 Sulfur Dioxide Data (in $\mu g/m^3$)

| County and City | Site Location | Operator | Method | Annual Average | MAX 3-Hr | MAX 24-Hr | NO. OF EXCEEDANCES 3-Hr Days | NO. OF EXCEEDANCES 24-Hr Times | 1-Hr Samples |
|---|---|---|---|---|---|---|---|---|---|
| APACHE: | | | | | | | | | |
| St. Johns | Mesa Parada | SRP | Fluor | 5 | 28 | 42 | 0 | 0 | 6941 |
| Springerville | 4 mi NE of town | Cent | Fluor | 3 | 58 | 13 | 0 | 0 | 7832 |
| Springerville | Airport | Cent | Fluor | 3 | 24 | 15 | 0 | 0 | 7146 |
| Springerville | 1 m NNE-unit 1 stack | Cent | Fluor | 5 | 139 | 42 | 0 | 0 | 8555 |
| Springerville | 1 m ESE-unit 1 stack | Cent | Fluor | 5 | 110 | 26 | 0 | 0 | 8565 |
| Springerville | 1 m SSE-unit 1 stack | Cent | Fluor | 5 | 181 | 34 | 0 | 0 | 8597 |
| Springerville | 12.2 m SE-unit 1 stk | Cent | Fluor | 3 | 34 | 10 | 0 | 0 | 7717 |
| COCONINO: | | | | | | | | | |
| Page | Glen Canyon Dam | SRP | Fluor | 5 | 165 | 52 | 0 | 0 | 8114 |
| GILA: | | | | | | | | | |
| Hayden | Garfield Ave | ASARCO | Fluor | 23 | 939 | 263 | 0 | 0 | 8742 |
| Hayden | Jail | ASARCO | Fluor | 19 | 821 | 163 | 0 | 0 | 8704 |
| Hayden | Hayden Junctions | ASARCO | Fluor | 9 | 319 | 50 | 0 | 0 | 8704 |
| Hayden | Montgomery Ranch | ASARCO | Fluor | 41 | 692 | 187 | 0 | 0 | 8704 |
| Hayden | Jail | State | Fluor | 16 | 1137 | 199 | 0 | 0 | 8129 |
| Miami | Jones Ranch | State | Fluor | 16 | 762 | 141 | 0 | 0 | 8097 |

**Table 9 (Cont'd)**

1990 Sulfur Dioxide Data (in $\mu g/m^3$)

| County and City | Site Location | Operator | Method | Annual Average | MAX 3-Hr | MAX 24-Hr | NO. OF EXCEEDANCES 3-Hr Days | NO. OF EXCEEDANCES 24-Hr Times | 1-Hr Samples |
|---|---|---|---|---|---|---|---|---|---|
| GILA (CONT'D): | | | | | | | | | |
| Miami | Jones Ranch | Cyprus M | Fluor | 12 | 730 | 132 | 0 | 0 | 8760 |
| Miami | Whtfld/Burch Pmp Sta | Cyprus M | Fluor | 2 | 87 | 11 | 0 | 0 | 8760 |
| Miami | Town Site | Cyprus M | Fluor | 4 | 430 | 54 | 0 | 0 | 8760 |
| Winkelman | 1 mi N Jct 77 & 177 | ASARCO | Fluor | 37 | 1153 | 292 | 0 | 0 | 8707 |
| MARICOPA: | | | | | | | | | |
| Phoenix | 1845 E Roosevelt | Maricopa | Fluor | 8 | 56 | 34 | 0 | 0 | 6615 |
| MOHAVE: | | | | | | | | | |
| Bullhead City | 224 N Main | SCE | Fluor | 5 | 202 | 39 | 0 | 0 | 8513 |
| Holiday Shores | 1436 Tonto Dr | SCE | Fluor | 3 | 126 | 18 | 0 | 0 | 8471 |
| Riviera | Fort Mohave | SCE | Fluor | <3 | 131 | 21 | 0 | 0 | 8566 |
| PIMA: | | | | | | | | | |
| Saguaro NM | 3905 S Old Spanish Trail | NPS | Coul | N/R | N/R | N/R | N/R | N/R | N/R |
| Tucson | 22nd & Craycroft | Pima | Fluor | 5 | 52 | 21 | 0 | 0 | 8478 |
| PINAL: | | | | | | | | | |
| Oracle | Courthouse | Magma | Fluor | 6 | 184 | 220 | 0 | 0 | 8750 |

**Table 9 (Cont'd)**

1990 Sulfur Dioxide Data (in $\mu g/m^3$)

| County and City | Site Location | Operator | Method | Annual Average | MAX 3-Hr | MAX 24-Hr | NO. OF EXCEEDANCES 3-Hr Days | NO. OF EXCEEDANCES 24-Hr Times | 1-Hr Samples |
|---|---|---|---|---|---|---|---|---|---|
| PINAL (CONT'D): | | | | | | | | | |
| Oracle | 3 C Ranch | Magma | Fluor | 8 | 177 | 181 | 0 | 0 | 8747 |
| San Manuel | Townsite | Magma | Fluor | 20 | 1257 | 222 | 0 | 0 | 8746 |
| San Manuel | Golf Course | Magma | Fluor | 22 | 660 | 123 | 0 | 0 | 8750 |
| San Manuel | Dormsite | Magma | Fluor | 16 | 763 | 96 | 0 | 0 | 8753 |
| San Manuel | Minesite | Magma | Fluor | 12 | 413 | 87 | 0 | 0 | 8752 |
| San Manuel | LDS Church | State | Fluor | 13 | 1053 | 139 | 0 | 0 | 8668 |
| San Manuel | Elks | Magma | Fluor | 32 | 1227 | 209 | 0 | 0 | 8749 |
| San Manuel | Hospital | Magma | Fluor | 33 | 916 | 60 | 0 | 0 | 8751 |

| STATE AND FEDERAL STANDARDS ($\mu g/m^3$): | Annual Average | 24-Hour Average | 3-Hour Average |
|---|---|---|---|
| Primary | 80 | 365 | ---- |
| Secondary | | | 1300 |

**Table 10**

1990 Sulfates Data (in $\mu g/m^3$) in TSP and $PM_{10}$

| County and City | Site Location | Operator | IN | Annual Average | 24-HR AVERAGE Max | 2ndHi | Number of Samples |
|---|---|---|---|---|---|---|---|
| APACHE: | | | | | | | |
| Petrified Forst | 1 mi. N of Park Hdqrtrs | NPS | PM10 | N/R | N/R | N/R | N/R |
| COCHISE: | | | | | | | |
| Chiricahua | Faraway Ranch | NPS | PM10 | N/R | N/R | N/R | N/R |
| Douglas | City Park | State | PM10 | $0.9^c$ | 7.9 | 3.6 | 39 |
| Paul Spur | Housing area | State | PM10 | $1.7^c$ | 5.4 | 3.8 | 15 |
| COCONINO: | | | | | | | |
| Grand Canyon | Hopi Point | NPS | PM10 | N/R | N/R | N/R | N/R |
| GILA: | | | | | | | |
| Hayden | Jail | State | PM10 | 2.0 | 6.1 | 5.2 | 55 |
| Miami Tailings | Southwest Gas Yd-Hwy 88 | State | PM10 | $2.4^c$ | 6.7 | 5.9 | 29 |
| Tonto | Maintenance Station | NPS | PM10 | N/R | N/R | N/R | N/R |
| GRAHAM: | | | | | | | |
| Safford | 523 Tenth Ave | State | PM10 | $0.5^c$ | 2.0 | 2.0 | 17 |
| MARICOPA: | | | | | | | |
| Glendale | 6000 W Olive | Maricopa | PM10 | $4.4^c$ | 9.3 | 8.6 | 16 |
| Phoenix | 1845 E Roosevelt | Maricopa | PM10 | $2.8^c$ | 5.5 | 3.5 | 24 |

**Table 10 (Cont'd)**

1990 Sulfates Data (in $\mu g/m^3$) in TSP and $PM_{10}$

| County and City | Site Location | Operator | IN | Annual Average | 24-HR AVERAGE Max | 24-HR AVERAGE 2ndHi | Number of Samples |
|---|---|---|---|---|---|---|---|
| MARICOPA CONT'D: | | | | | | | |
| Phoenix | 4732 S Central | Maricopa | PM10 | 2.5[c] | 5.6 | 3.6 | 19 |
| Phoenix | 3847 W Earll | Maricopa | PM10 | 3.3[c] | 7.3 | 6.2 | 34 |
| Scottsdale | 2857 N Miller Rd | Maricopa | PM10 | 3.3[c] | 6.1 | 5.5 | 17 |
| PIMA: | | | | | | | |
| Ajo | Well Rd | State | PM10 | 0.4[c] | 3.3 | 2.8 | 14 |
| Organ Pipe NM | Visitors Center | State | PM10 | 1.1 | 3.7 | 3.6 | 55 |
| Rillito | 8820 W Water | State | PM10 | 1.9 | 5.0 | 4.7 | 53 |
| Saguaro | Rincon Mountain Unit | NPS | PM10 | N/R | N/R | N/R | N/R |
| Tucson | .5 m E Irvgtn & Alvrnon | TEP | PM10 | 2.5 | 5.9 | 5.1 | 59 |
| PINAL: | | | | | | | |
| Casa Grande | 401 Marshall Rd | State | PM10 | 0.7[c] | 3.4 | 3.3 | 21 |
| SANTA CRUZ: | | | | | | | |
| Nogales | US Post Office | State | PM10 | 1.6 | 5.1 | 4.7 | 52 |
| YAVAPAI: | | | | | | | |
| Nelson | 3 mi W of lime plant | State | TSP | 2.6 | 5.5 | 5.4 | 48 |
| YUMA: | | | | | | | |
| Yuma | 2795 Avenue B | State | PM10 | 1.9[c] | 4.6 | 3.9 | 18 |

**TABLE 11**

$PM_{10}$ Concentrations in Various Cities
Annual Arithmetic Mean ($\mu g/m^3$)

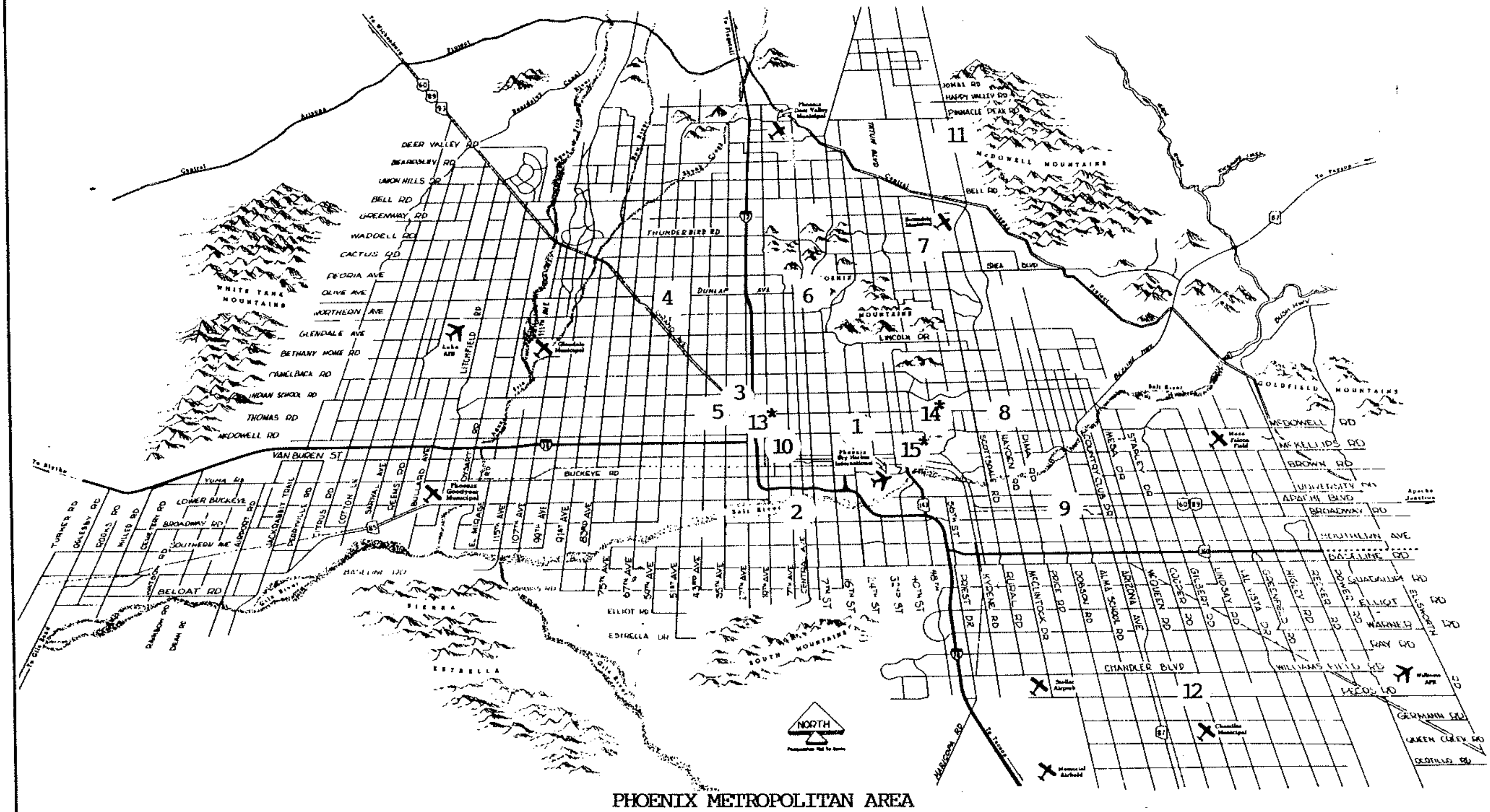
| SITE | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|
| Ajo | 41 | 36 | 39 | 42 | 41 | 44 |
| Bullhead City | -- | -- | -- | 37 | 52 | 39 |
| Apache Junction | -- | -- | 22 | 22 | 16 | 23 |
| Casa Grande | -- | 60 | 36 | 44 | 43 | 32 |
| Clarkdale | -- | -- | -- | -- | 24 | 28 |
| Douglas (City Park) | 62 | 59 | 52 | 57 | 55 | 38 |
| Flagstaff | 39 | 38 | 29 | 21 | 24 | 29 |
| Hayden | 68 | 80 | 56 | 52 | 46 | 35 |
| Joseph City | -- | -- | 20 | 25 | 26 | 21 |
| Nogales | 56 | 76 | 72 | 69 | 63 | 52 |
| Organ Pipe | 18 | 16 | 17 | 16 | 19 | 23 |
| Paul Spur | 106 | 111 | 56 | 79 | 122 | 79 |
| Payson | -- | -- | 40 | 77 | 79 | 67 |
| Rillito | 66 | 55 | 59 | 69 | 94 | 40 |
| Safford | 49 | 40 | 32 | 42 | 44 | 28 |
| Show Low | -- | 32 | 25 | 23 | 23 | 22 |

[a] Mean value based on a limited number of samples.

Annual standard - 50 $\mu g/m^3$

Figure 1

Maricopa County Monitoring Network

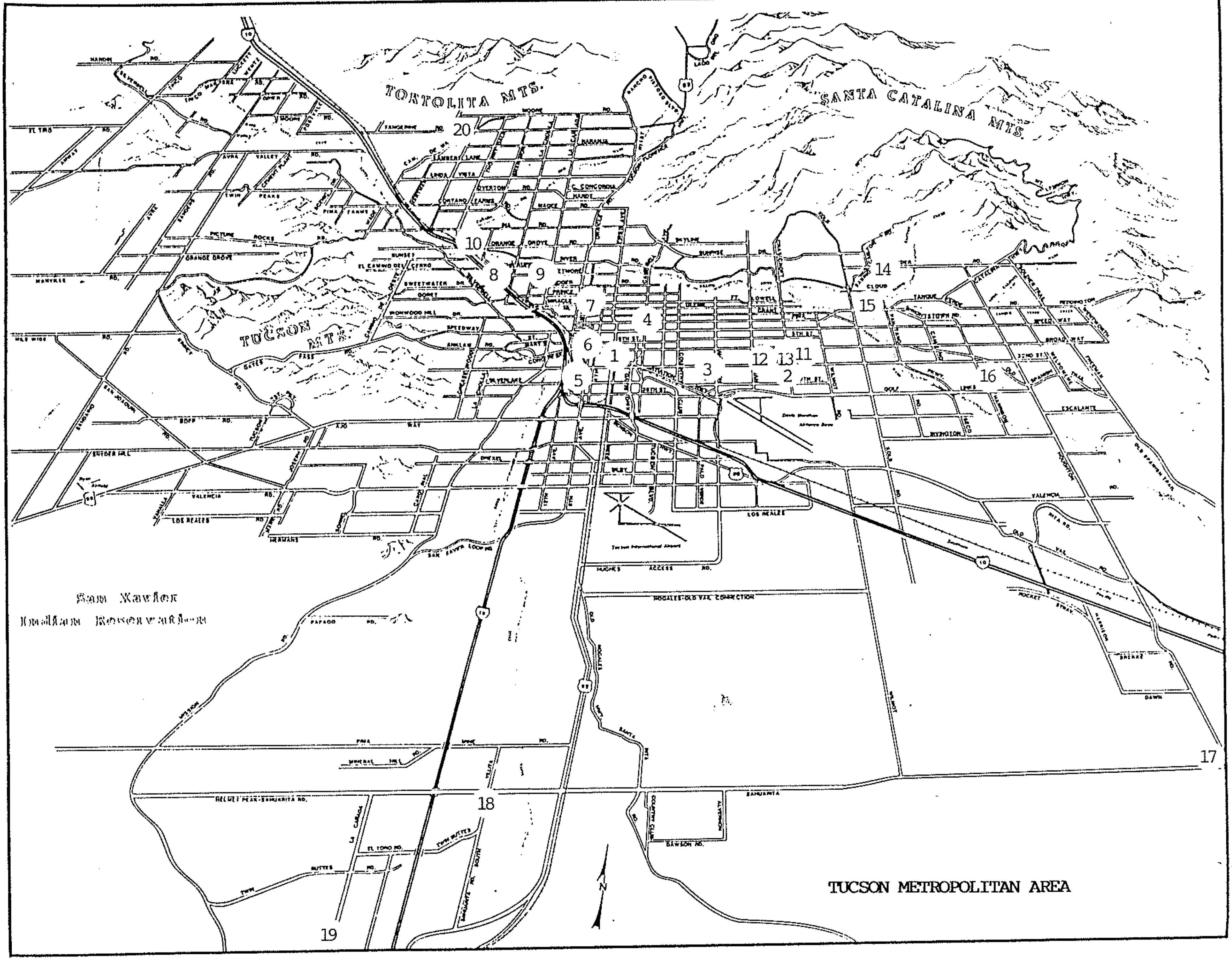


## Map Key for Figure 1
## Maricopa County Monitoring Network

| Map Number | Site |
|---|---|
| 1 | 1845 East Roosevelt - Phoenix |
| 2 | 4732 South Central - Phoenix |
| 3 | 3315 West Indian School - Phoenix |
| 4 | 6000 West Olive - Glendale |
| 5 | 3847 West Earll - Phoenix |
| 6 | 601 East Butler - Phoenix |
| 7 | 13665 North Scottsdale - Scottsdale |
| 8 | 2857 North Miller - Scottsdale |
| 9 | Broadway & Brooks - Mesa |
| 10 | 1826 West McDowell - Phoenix |
| 11 | 24301 North Alma School - Scottsdale |
| 12 | 1475 East Pecos - Chandler |
| 13* | 2039 West Lewis - Phoenix |
| 14* | 2035 North 52nd Street - Scottsdale |
| 15* | 600 North 40th Street - Phoenix |

* State operated

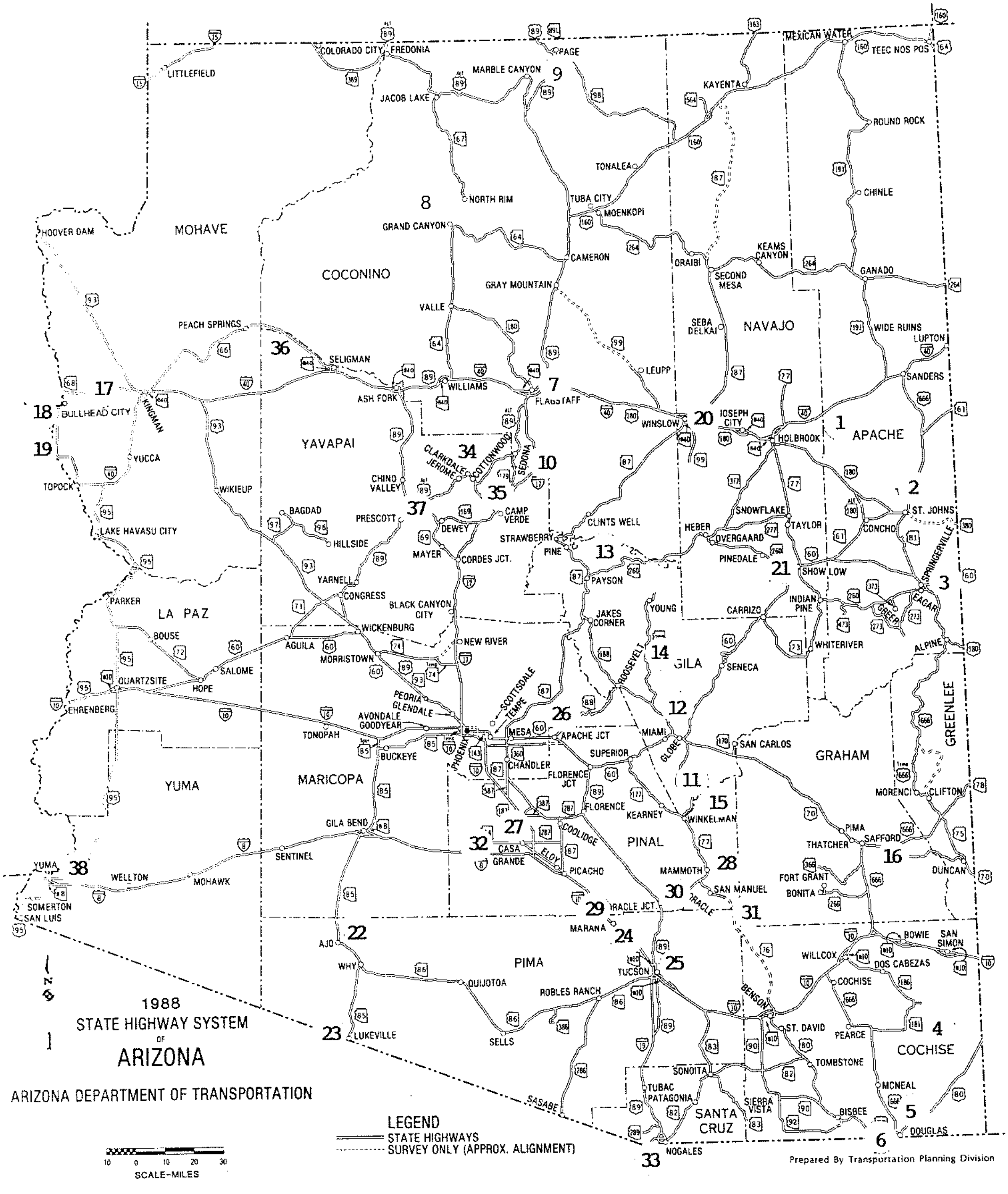
Figure 2
Pima County Monitoring Network



**Map key for Figure 2**
**Pima County Monitoring Network**

| Map Number | Site |
|---|---|
| 1 | 150 West Congress |
| 2 | 22nd & Craycroft |
| 3 | 22nd & Alvernon |
| 4 | 2745 North Cherry |
| 5 | 1810 South 6th Avenue - South Tucson |
| 6 | 2nd Street & Palm |
| 7 | 1016 West Prince |
| 8 | 3600 North Silverbell - Silverbell Park |
| 9 | 4591 North Pomona |
| 10 | 3401 West Orange Grove |
| 11 | 346 North Cloverland - Highland Park |
| 12 | 4575 East Broadway |
| 13 | Broadway & Craycroft |
| 14 | 4829 North Sabino Canyon |
| 15 | 7290 East Tanque Verde |
| 16 | 2181 South Harrison |
| 17 | 2200 South Houghton - Corona de Tucson |
| 18 | 350 West Helmet Peak - Sahuarita Jr. High School |
| 19 | 241 West Esperanza - Green Valley |
| 20 | 12101 North Camino de Oste |

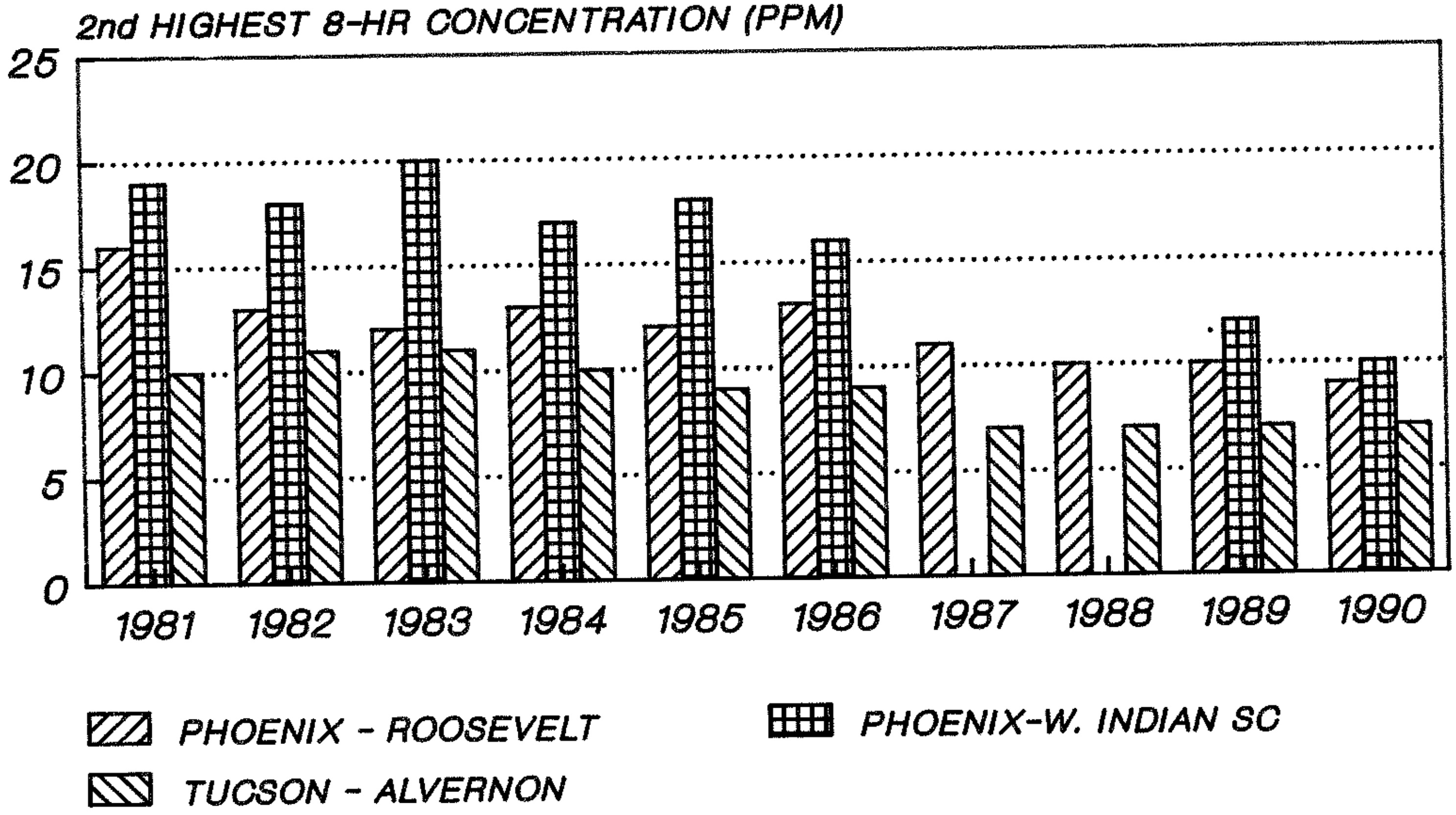
Figure 3
State and Industrial Monitoring Networks



## Map Key for Figure 3
## State and Industrial Monitoring Networks

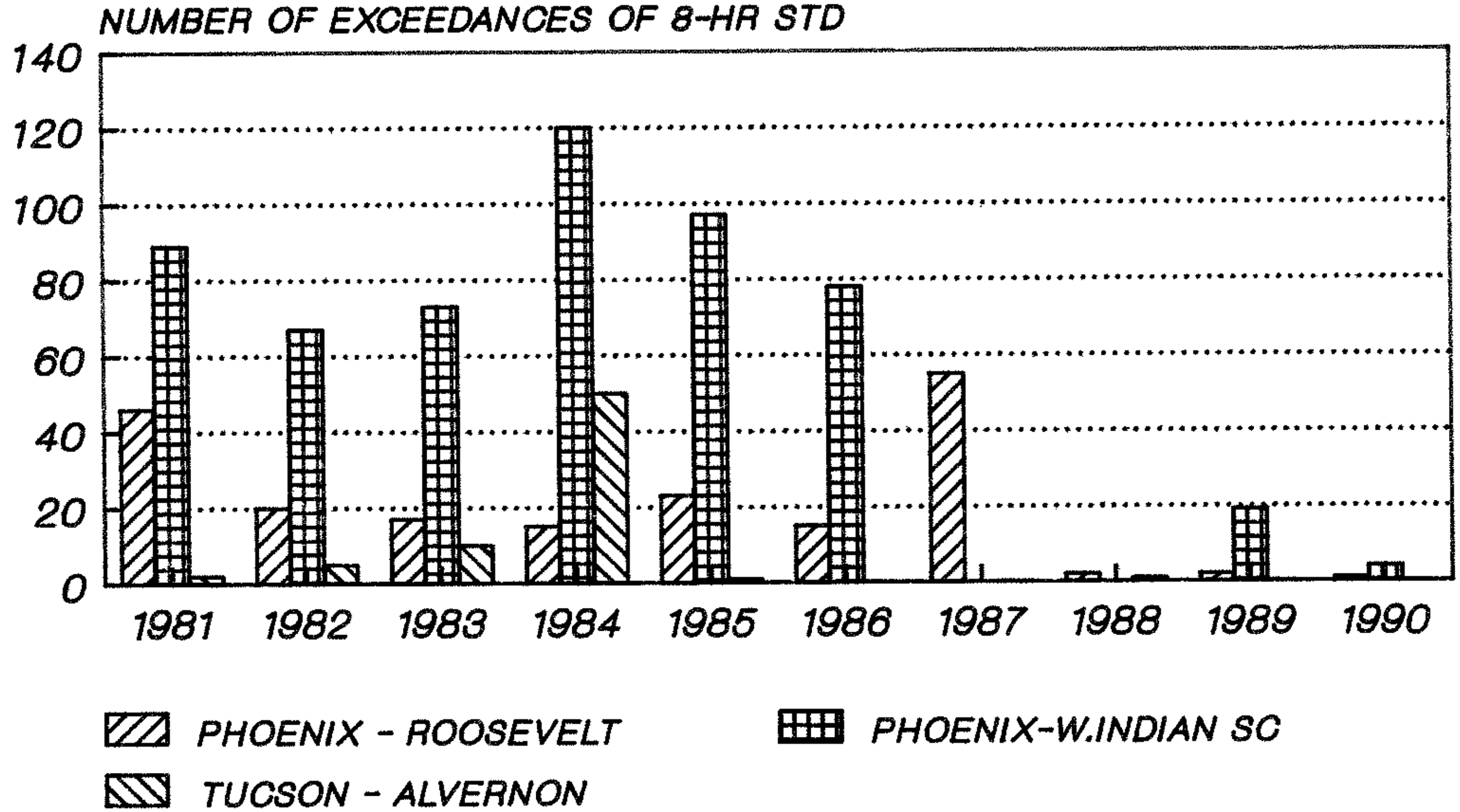
| Map Number | County | Town |
|---|---|---|
| 1 | Apache | Petrified Forest |
| 2 | | St. Johns |
| 3 | | Springerville |
| 4 | Cochise | Chiricahua |
| 5 | | Douglas |
| 6 | | Paul Spur |
| 7 | Coconino | Flagstaff |
| 8 | | Grand Canyon |
| 9 | | Page |
| 10 | | Sedona |
| 11 | Gila | Hayden |
| 12 | | Miami |
| 13 | | Payson |
| 14 | | Tonto |
| 15 | | Winkelman |
| 16 | Graham | Safford |
| 17 | Mohave | Bullhead City |
| 18 | | Holiday Shores |
| 19 | | Riviera |
| 20 | Navajo | Joseph City |
| 21 | | Show Low |
| 22 | Pima | Ajo |
| 23 | | Organ Pipe |
| 24 | | Rillito |
| 25 | | Saguaro N.M. |
| 26 | Pinal | Apache Junction |
| 27 | | Casa Grande |
| 28 | | Mammoth |
| 29 | | Marana |
| 30 | | Oracle |
| 31 | | San Manuel |
| 32 | | Stanfield |
| 33 | Santa Cruz | Nogales |
| 34 | Yavapai | Clarkdale |
| 35 | | Montezuma Castle |
| 36 | | Nelson |
| 37 | | Prescott |
| 38 | Yuma | Yuma |

# FIGURE 4
# CARBON MONOXIDE CONCENTRATIONS IN PHOENIX AND TUCSON



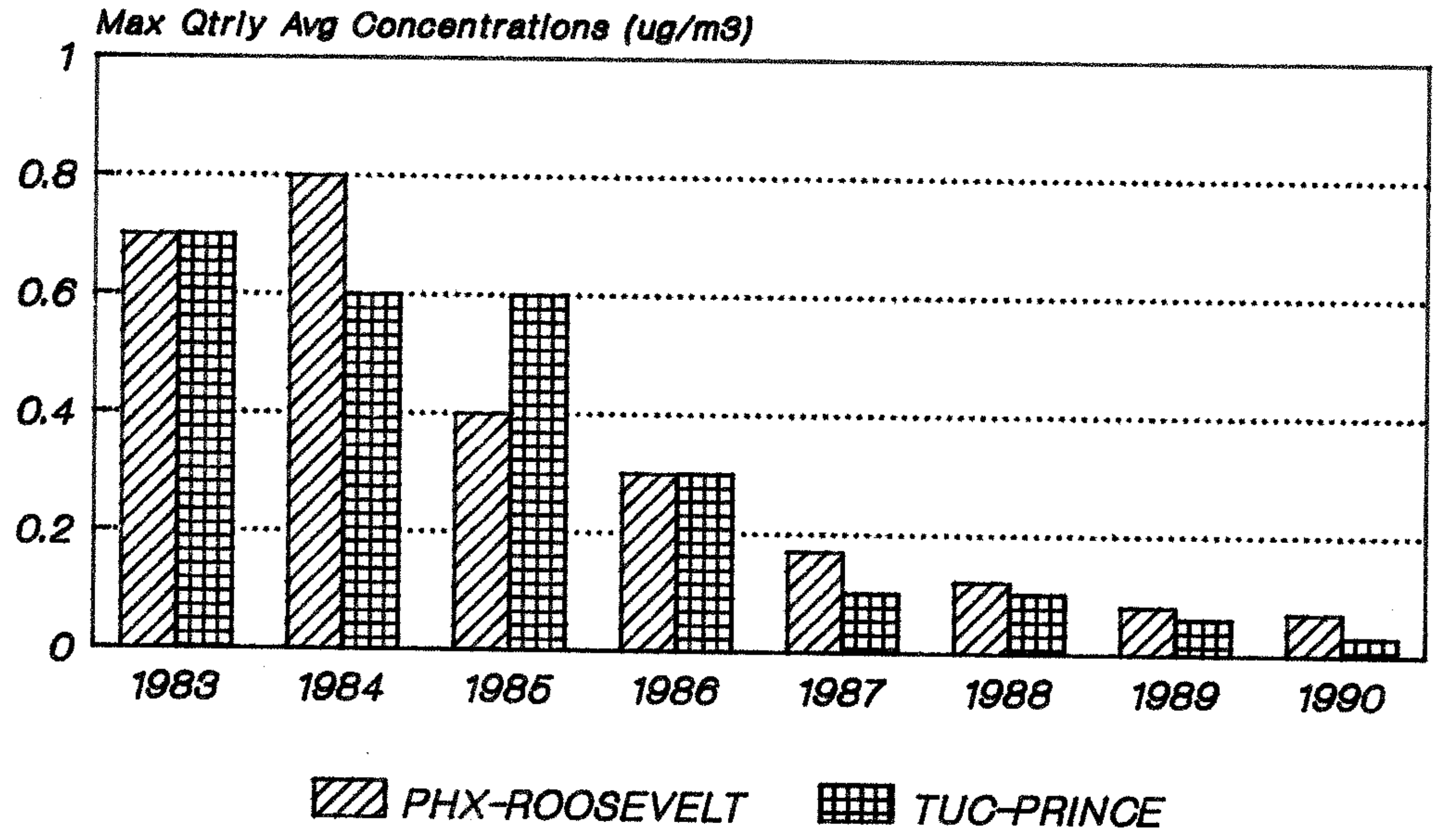

STANDARD IS 9 PPM

# FIGURE 5
# CARBON MONOXIDE EXCEEDANCES IN PHOENIX AND TUCSON



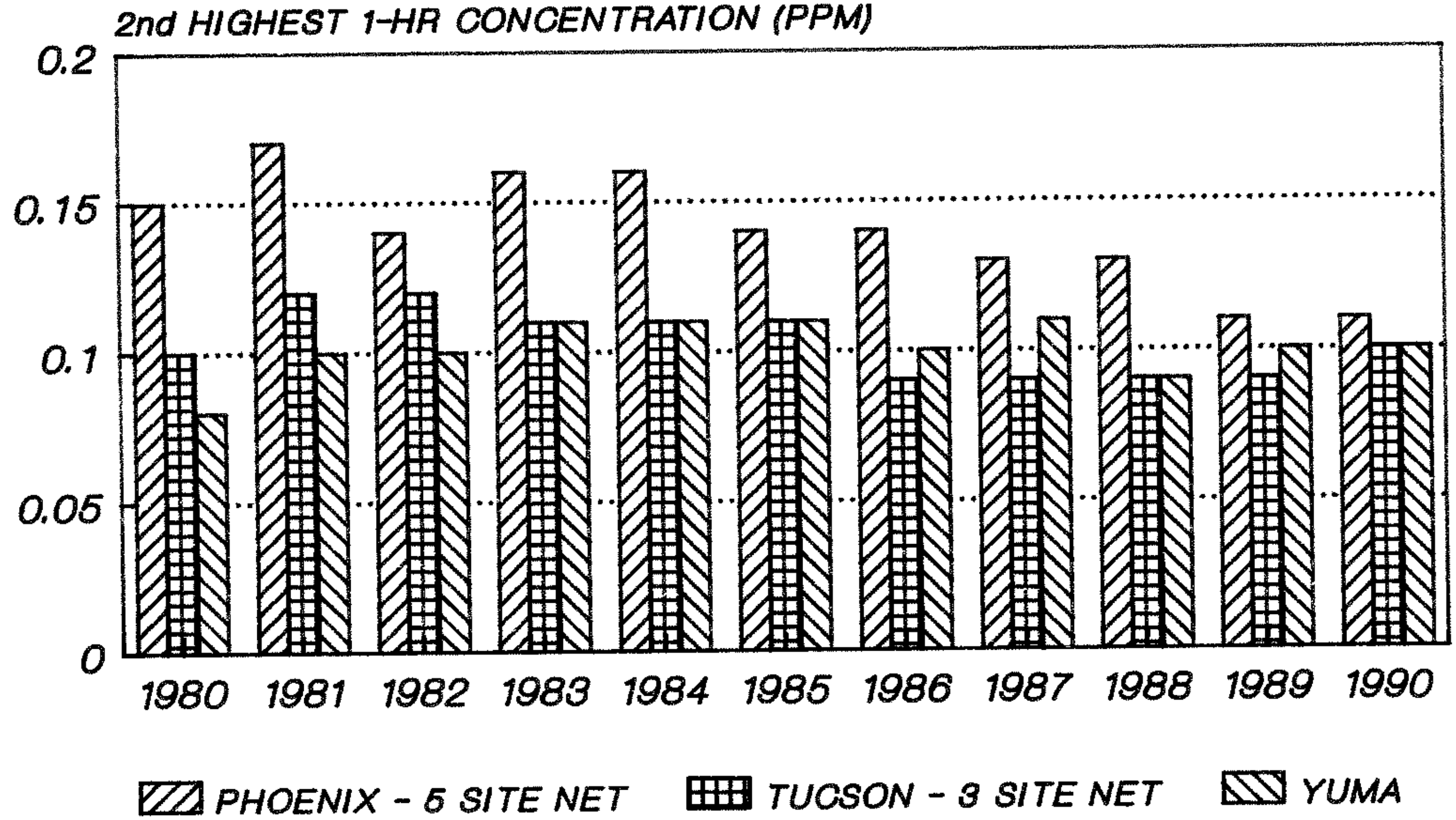

**STANDARD IS 9 PPM**

# FIGURE 6
# LEAD CONCENTRATIONS IN PHOENIX AND TUCSON



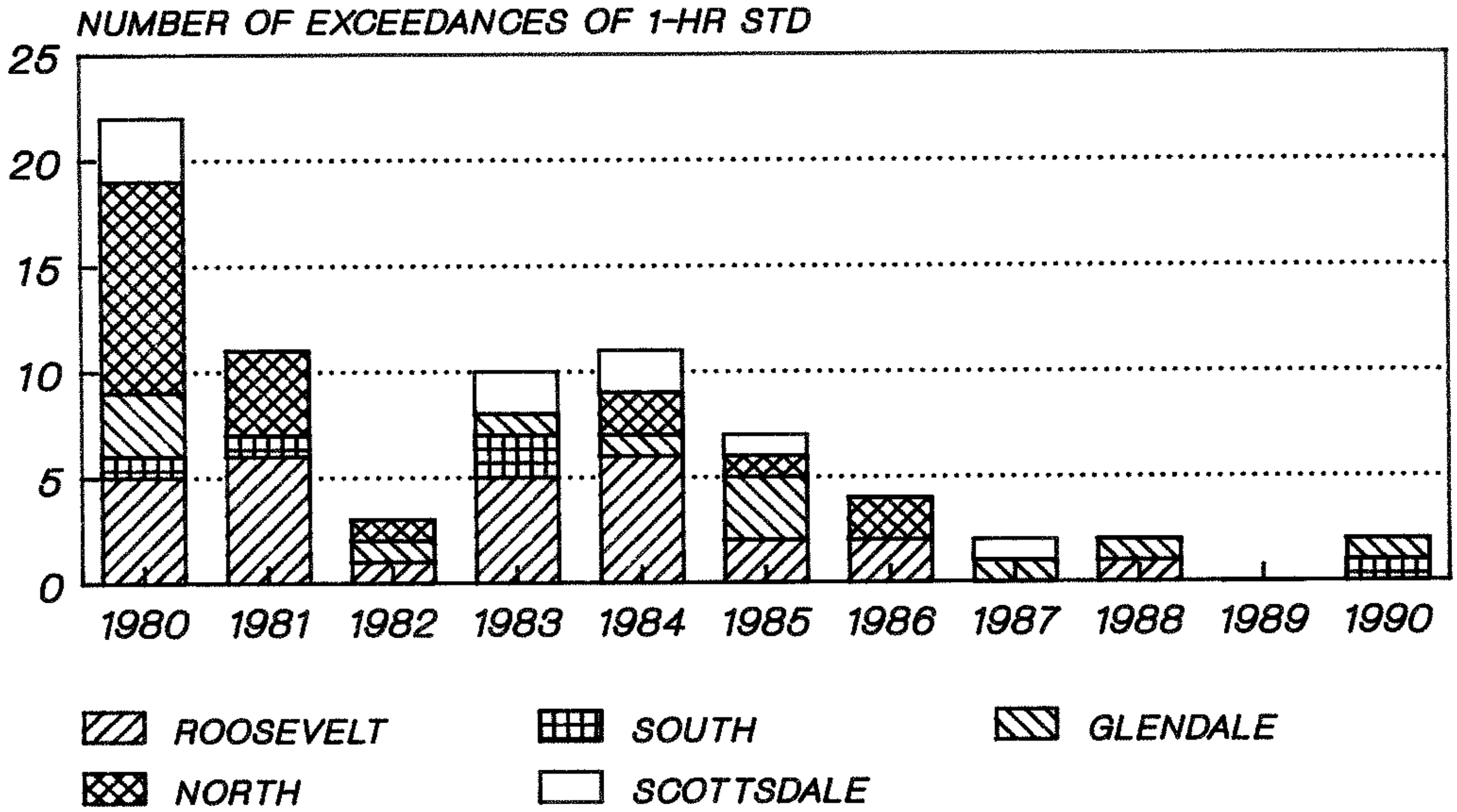

Standard is 1.5 (ug/m3)

## FIGURE 7
## OZONE CONCENTRATIONS IN PHOENIX, TUCSON AND YUMA



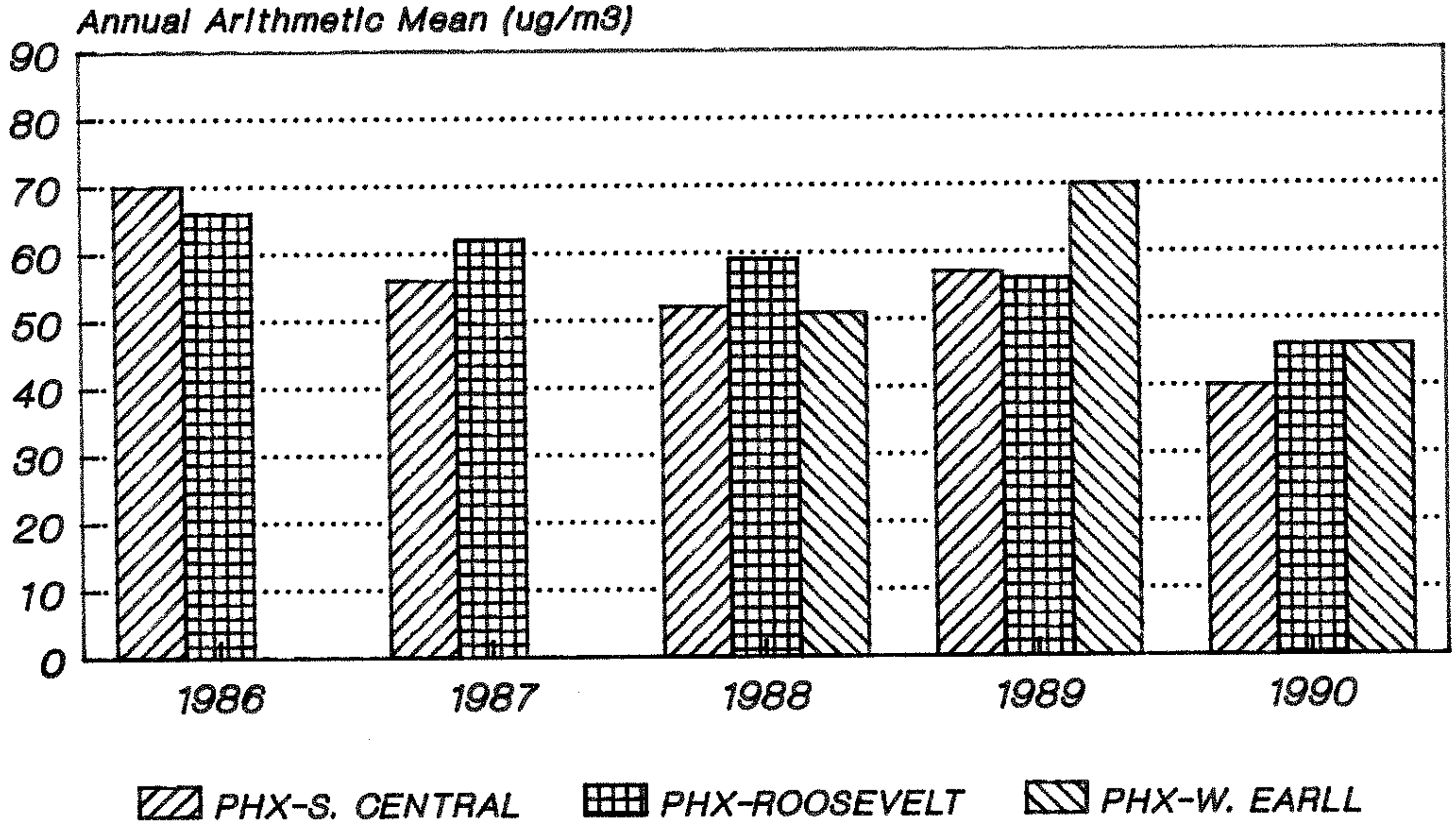

STANDARD IS .12 PPM

# FIGURE 8
# OZONE EXCEEDANCES
# FOR PHOENIX 5 SITE NETWORK



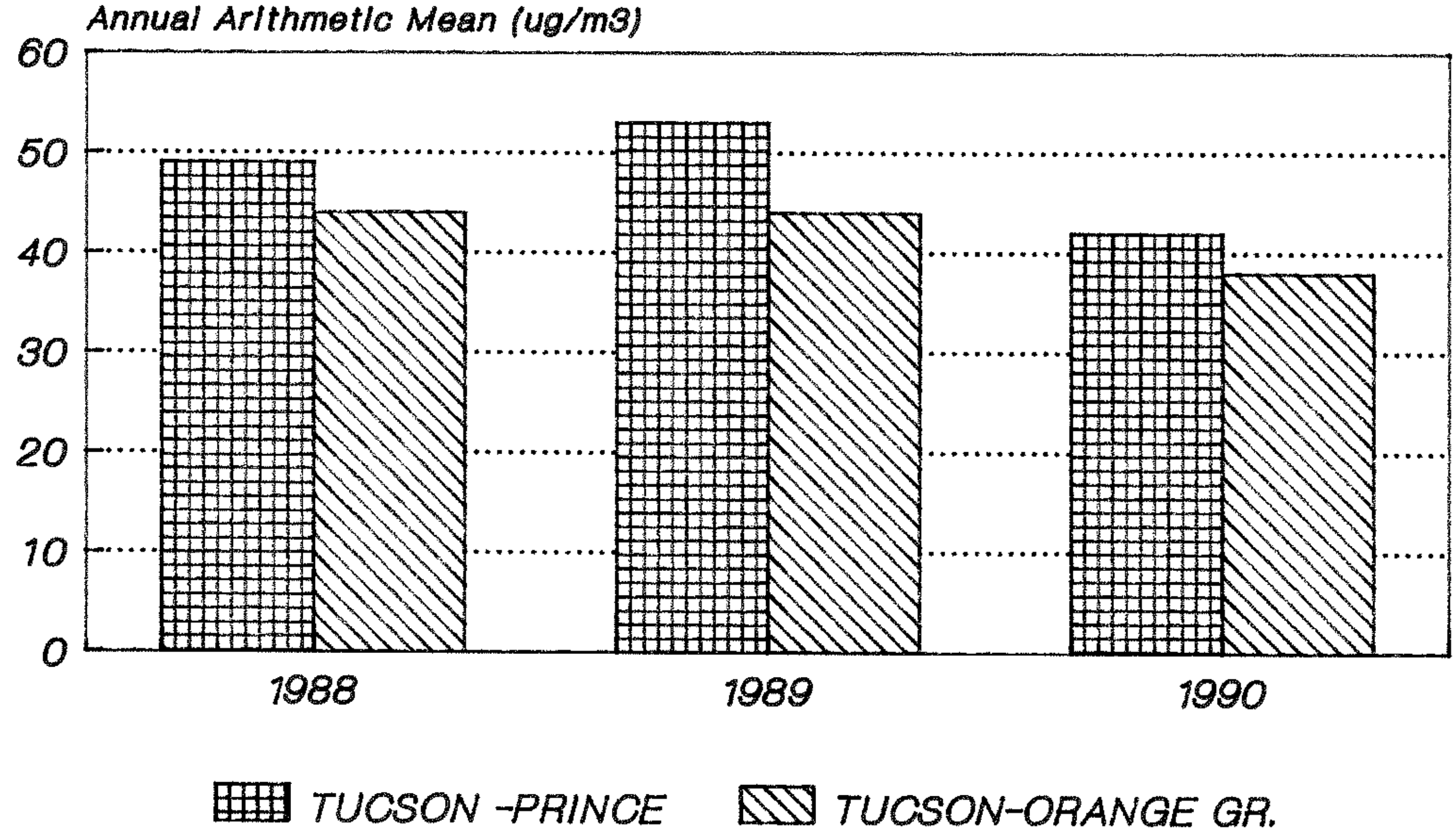

STANDARD IS .12 PPM

# FIGURE 9
# PM10 CONCENTRATIONS IN PHOENIX



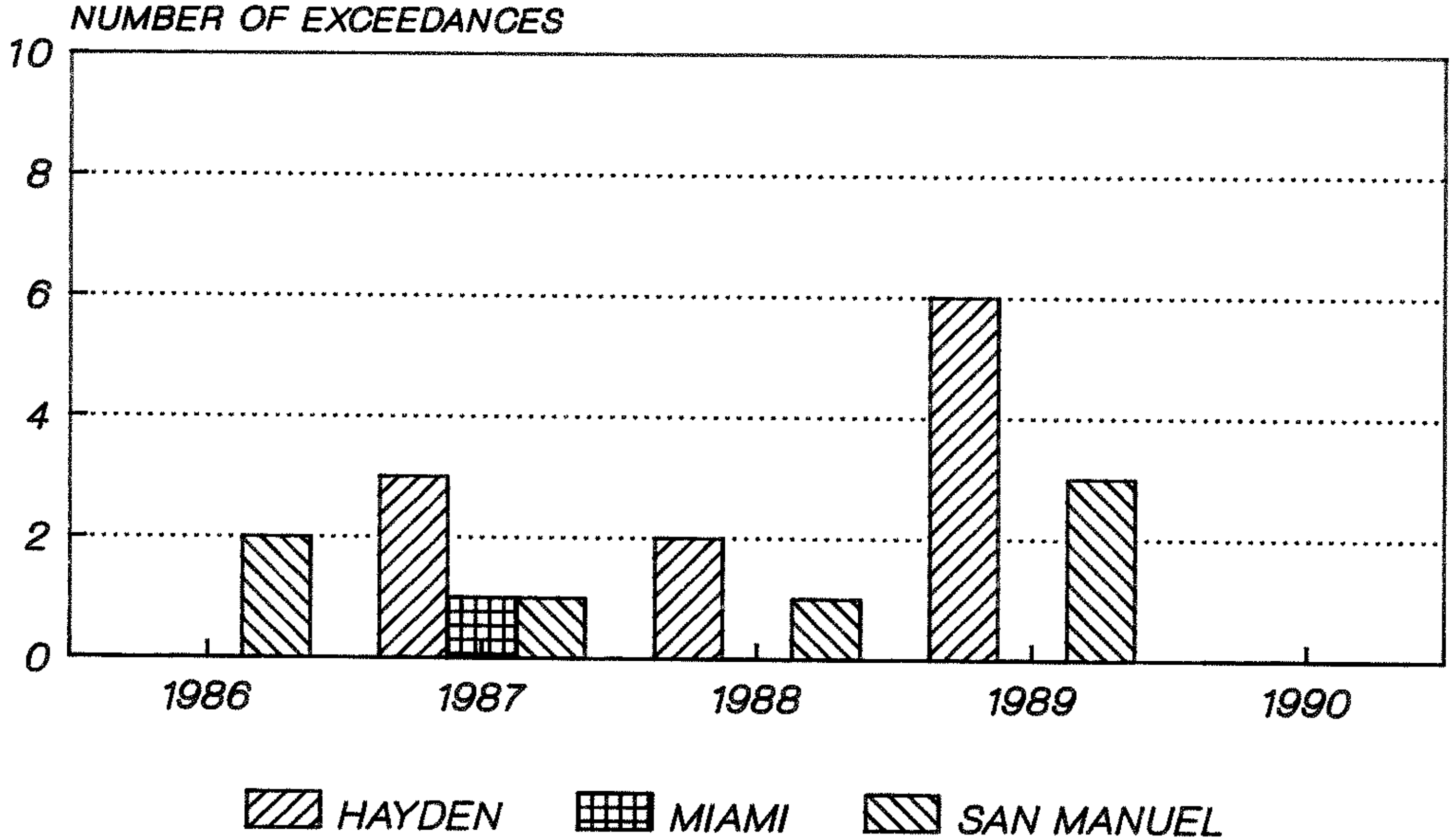

**Standard is 50 (ug/m3)**

# FIGURE 10
# PM10 CONCENTRATIONS IN TUCSON




Standard Is 50 (ug/m3)

# FIGURE 11
# SULFUR DIOXIDE 3 - HR EXCEEDANCES IN SMELTER TOWNS




*Air Quality Standard is 1300 ug/m3 (3hr)*